AN ECONOMIC ANALYSIS OF CRIME IN HONG KONG

by

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To My Parents

ABSTRACT

Economic analysis of crime assumes potential offenders react to incentives according to our state-preference theory. We have used quarterly time series data of offences against property and the person for empirical testing. We find that the probabilities of being imprisoned and fined accompanied by lengthy imprisonment are important deterrence factors for both catagories of crimes. Moreover, the labour market conditions also affect the offence rate against property.

The offence rate against property and the person are measured by the number of cases reported per 1000 population. Simple linear, double logarithmic and semi-logarithmic functional forms are used and they give us similar results.

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Chapter 1

Introduction

The economic analysis of crime has a much shorter history than the sociological approach. Most economists would agree that the appearance of Gary S. Becker's seminal article " Crime and Punishment : an Economic Approach " in 1968 was a starting point.[1] A systematic study of enforcement as an economic problem followed.[2] In our analysis, we assume a potential offender reacts to incentives. The opportunities faced by him include deterrence variables like probabilities of being caught, fined, jailed as well as the severity of punishment; while the environmental conditions affecting his devotion to criminal activities include illegal and legal returns, unemployment rate, etc. A simple time allocation model is used and potential offenders are presumed to act as expected-utility maximizers.

In Hong Kong, the studies of crime were basically done by social workers and sociologists. Most of these studies are concerned with juvenile delinquency. Although juvenile delinquency is a problem in our society, most of the crimes are committed by adults. Researchers in Hong Kong have paid a disproportionately small amount of attention to adult crimes. In 1980, the percentage of juveniles prosecuted for property crimes out of all prosecuted was 19.4%, and this was already the highest known figure. From 1983 to 1987, the percentage remained below 13%.

Our economic model assumes individuals behave rationally. Offenders react to incentives just as we do. The percentage of prisoners who have committed property crimes more than once in the last two years is shown in table 1a. Almost half of the prisoners' population has criminal record already. Ignorance is unlikely to be the excuse for these hand core offenders

Table 1a

Percentage of recidivism within the last two years for property crimes

	Male prisoners	Female prisoners
1975	64.4	33.3
1976	67.5	29.4
1977	69.4	53.8
1978	67.2	41.5
1979	63.4	44.3
1980	62.4	21.5
1981	29.6	52.8
1982	43.8	33.8
1983	44.3	30.5
1984	46.3	30.2
1985	52.2	50.0
1986	48.5	46.4
1987	49.5	45.1

Source : Statistical Tables, Correctional Services Department

1.1 Period and Scope of Study

The period of study begins from the middle of 1975 until the end of 1987. There are two main reasons for such a choice. In the first place, economic analysis of crime suggests that the decision of criminal participation is rational. A potential offender would determine his devotion to legitimate and illegitimate activities based on costs and benefits analysis. In the period chosen, our economy experienced a lot of fluctuation and this inevitably provided valuable information for empirical research. Secondly, our model requires collecting data from various sources and we are constrained by data limitation.

During the period 1975 to 1987 , our economy experienced three recoveries from recessions. Two of them were caused by the oil crises in 1973/74 and 1979/80. Hong Kong was no exception to the shock and the economy did experience a very low growth rate. The recent recession in 1985 caused the real total Gross Domestic Product (GDP) and per capita GDP growth rates to go down to 0.6% and -0.5%.

However , Hong Kong has recovered quickly after each recession. It was growing especially fast after the first oil crisis. In 1976, the real total GDP growth rate reached 18.8%. In 1981 (one year after the second oil crisis), the real growth rate was 9.4 % while in 1986 (one year after the recession in 1985), the corresponding figure was 11.8%[3]. The fluctuation has provided useful information for analyzing the relation between the labour market conditions and the crime rates.

Data limitation is inevitably the strongest restriction on our period of study. We suspect that the unemployment rate is a crucial factor in determining the crime rate because the failure to achieve ends by legitimate means would be substituted by illegitimate ones. The unemployment figures are obtained from the Labour Force Surveys and the General Household Surveys. The former, which commenced operation in September 1975, were replaced by the latter starting from August 1981. Therefore, the study could only begin from the third quarter of 1975 using quarterly data. Moreover, some important data in the Annual Statistical Tables for 1988 of the Correctional Service Department are still unavailable, so we cannot extend the period beyond 1987 in the meantime.

Following the initiation of the Four Modernization Programmes in December 1978 and the adoption of the open policy in 1979, China became one of our most important sources of illegal immigrants, which has created many social and economic problems. In 1979, the estimated number of illegal immigrants was more than 110,000. These people were mainly in their 20s or 30s. After Hong Kong abandoned the touch-base policy on 23 October 1980, the number of immigrants, either legal or illegal, has been brought under control. The overall immigration (both legal and illegal) reduced from 101,605 in 1980 to 33,150 in 1981. Table 1b.

Table 1b

Number of Immigrants from 1979 to 1982

	1979	1980	1981	1982
Net immigration from China	67,709	52,885	52,004	51,356
Net immigration from other countries	-1,122	-27,408	-23,400	-31,014
Illegal immigration (estimated)	112,605	76,128	4,546	2,997
Balance	179,192	101,605	33,150	23,339

Source : 1982 Economic Background , p.36

In a case study of 30 male offenders aged 15 - 45 who were new immigrants from China between 1976 to 1983[4], there were several factors which made this group of people more prone to criminal activities. These factors included cultural differences, low social status, lack of incompetitiveness in the job market, poor living conditions, no sense of belonging and poor communication with local people.

1.2 Local Studies on Criminal Activities

The sociological study of crime has a long history and there are a number of theories on the subject. However, we would only describe one of them which has been applied in Hong Kong some years ago. It is known as the Control Theory by Travis Hirshi. The theory states that an individual is constrained by internal and external controls. The former include guilt, shame, etc., while external controls include surveillance, supervision, etc.. Crime and delinquency are undertaken by those who are least constrained. In other words, the upsurge of criminal activities is caused by the weakening of bonds between individuals and various institutions, especially family, community, school and place of work.[5] The rising number of working women is expected to weaken the family bond of children. The juvenile delinquency rate could then be related to the female labour force participation rate. In addition, the quit rate of students also reflect the weakened bond between schools and students. Therefore, both female labour force participation rate and the students' quit rate would be included in our empirical model.

Both theoretical and empirical researches on crime and delinqency are relatively limited in Hong Kong. Local sociological studies on criminal activities, especially juvenile delinquency , were mainly based on questionnaires and interviews. Among those available studies on juvenile delinquency, the methodologies for hypotheses testing are less satisfactory. A rather large scale study on juvenile

delinquency was done in 1974 based on the Control Theory approach. Agnes Ng[6] , who was the person-in-charge of the research, had chosen two groups of adolescents (offenders and non-offenders) between the age of 12 to 20 for a matched sample design.

According to the Control Theory, there are four elements which keeps us away (juvenile included of course) from criminal activities. The elements are : (i) attachment to others ; (ii) commitment to social values and norms; (iii) involvement in social activities ; (iv) belief in the moral validity of social codes.

The two groups of adolescents were asked about their parental relations, school performance, leisure activities, aspirations , etc. For each question , a chi-square testing was made question by question to determine if there was any difference between responses of both groups of adolescents. Notice that the Control Theory as a whole has not actually been tested.

The results were almost "expected". Offenders usually came from broken families , performed badly at school, got along with triad members, had little aspiration about their future, etc. The methodology of the research is less satisfactory because the chi-square testing is based on each characteristic rather than the Control Theory as a whole. Although she claimed that her investigation assumed the causes of crime and delinquency were multi-factorial, her model was not tested in such a way !

In 1979, the juvenile crime rate climbed up suddenly and a Working Group on Juvenile Crime was set up in late 1980's. The results published later indicated that all the pre-conditions recognized in Agnes' paper still existed, but the juvenile crime rate has already increased by a lot[7]. In 1973, the juvenile crime rate, measured by number of juveniles prosecuted per 100,000 of the juvenile (7 - 15) age group, was 160 ; it became 478 in 1980s. In other words, the empirical study could only list out some different characteristics between juvenile offenders and non-offenders. The method is unsuccessful in explaining the change in crime rate.

Another study was launched in Tsuen Wan and Kwai Chung District in the late 1985[8] and early 1986 which intended to study differences in parental supervision and schooling between delinquent and non-delinquent youths. Two groups of juveniles were chosen. The first group of 121 youths had committed at least one delinquent act while the other group of 58 had not.

The questionnaire was designed to investigate the young people's leisure activities, family and parental conditions and their relation with family members, etc. It was stated in the introduction to the report that the study was not meant to test any theoretical hypotheses. The report consisted of tables summarizing the responses of juvenile offenders and non-offenders. In other words, the set of data collected is still waiting for further analysis.

In a paper written by Harold Traver in 1980[9], the author tried to explain the trend of violent and property crimes by socio-economic changes during the late 50s and 70s.

In the paper, the housing (per 1000) and population density were used to measure urbanization. Industrialization was measured in terms of per capita electricity consumption, employment in manufacturing and per capita gross domestic product. Economic conditions were measured by wages, price level, number of vehicles ,TV, telephones per 1000 people.

Suspecting that the crime rates (violent and property) were related to these variables, the author simply plotted the crime rates against each of them. Some variables exhibit a similar trend for one period but not the other.

The author seemed to conclude that socio-economic variables were influential in the cyclical movement of crime rates. However, the extent to which they were influential was not addressed. Without any statistical testing, the conclusion of the paper was quite vague.

Chapter 2

Theoretical Framework and Implications

Economic analysis of crime began in the late 60s by Gary S. Becker[10]. He viewed the criminal participation as a form of rational behaviour similar to other decisions in labour market participation. In 1973, Isaac Ehrlich, whose PhD dissertation in 1970[11] was based on Becker's concept of rational criminal participation behaviour, published an empirical research paper on illegitimate participation.[12] In his paper , a time allocation model was set up and tested empirically . He used cross-sectional data of the United States of America on seven offences punishable by imprisonment, namely : robbery, burglary, larceny, auto theft, murder, rape and assault.

In the rest of the chapter, we would introduce Ehrlich's model in the first place. Based on his model, two other versions would also be discussed.

2.1 Ehrlich's One-period Model

He assumed that an individual would divide his available time between participating in two types of markets, namely: legitimate and illegitimate markets. Both of them require no training and entry cost, but the latter market is more risky. If a person takes part in the illegitimate market, he will receive a higher return but also a probability of being caught and punished. Once he is caught, the resulting wealth after punishment should be

lower than the wealth he would have acquired legitimately with the same amount of time. The decision-making problem is formulated by the state-preference theory.

Each person has a fixed amount of time $\bar{t}$ at his disposal. This amount would be the portion from which the basic time-consuming activities (e.g. sleeping, eating, etc.) are excluded. He can then devote a certain portion of the disposable time to each activity based on his expected cost and benefit analysis.

To begin our model, let us assume there are only two states of the world. State A represents the " caught state " which is unfavourable to the offender, state B is the "not caught state" which is favourable to him. Let us assume that the return from either market is positively related to one's time allocation. In other words, a full-time robber would have more loot from robbery than a part-time robber with other things being held constant of course. Let t_i and t_l denote the time spent on illegitimate and legitimate market with corresponding returns as $W(t_i)$ and $W(t_l)$, the individual's income in state B (i.e. " not caught state ") would be the sum of both returns and his initial wealth, says W. Notice that for an equal amount of time allocation in both markets, return of illegitimate market should be higher because of the risk. In other words, $W_i(t) > W_l(t)$. The payoff of the offender who is not caught is :

$$I_b = W + W_i(t_i) + W_l(t_l)$$

$$\bar{t} = t_i + t_l$$

$$t_i >= 0 \ ; \ t_l >= 0$$

Once he is caught and convicted, he would have to "pay" for his wrongdoings by means of a fine, an imprisonment, psychological costs of feeling guilty, etc. Let us assume all the pecuniary and non-pecuniary costs could be added up in $F_j(t_i)$. The severity of punishment is positively related to one's time allocation to illegitimate activities. This implies that a " full-time " criminal would face a more severe punishment than a " part-time " criminal if both are caught. Therefore,

$$I_a = W + W_i(t_i) + W_l(t_l) - F_i(t_i)$$

As mentioned before, once the offender is caught, the resulting wealth after punishment should be lower than the wealth acquired legitimately with the same amount of time. In other words, $W_l(t) > W_i(t) - F_i(t)$.

Let the potential offender's subjective probability of being caught is p. Correspondingly, 1 - p becomes his subjective probability of getting away with crime.

The economic approach assumes that an individual maximizes his expected utility EU(I) given his subjective probability of different states to occur as well as the subsequent payoffs.

$$EU(I) = p \ U(I_a) + (1 - p) \ U(I_b) \qquad ..... \ (1)$$

To determine the optimal amount of time allocation on

illegitimate activities (t_i), we differentiate (1) with respect to t_i

$$\frac{d\,EU(I)}{d\,t_i} = p\,U'(I_a)\,[W_i' - W_l' - F_i'] + (1-p)U'(I_b)\,[W_i' - W_l'] \quad \ldots\ldots (2)$$

where $W_i' = dW_i/dt_i > 0$; $W_l' = dW_l/dt_i > 0$;

$F_i' = dF_i/dt_i > 0$

Assuming an interior solution exists, we set the first derivative to zero and obtain

$$p\,U'(I_a)\,[W_i' - W_l' - F_i'] = -(1-p)U'(I_b)\,[W_i' - W_l']$$

$$\frac{W_i' - W_l'}{W_i' - W_l' - F_i'} = -\frac{p\,U'(I_a)}{(1-p)\,U'(I_b)} \quad \ldots\ldots (3)$$

For (3) to be a global maximum, it requires diminishing legitimate and illegitimate wages , diminishing marginal utility of real wealth and increasing marginal penalties i.e. W_i'' , W_l'', $U''(I_a)$, $U''(I_b) < 0$ and $F_i'' > 0$ (see Appendix 1 for the second order condition).

The left-hand side of (3) represents the marginal rate at which I_a can be transformed into I_b by reallocating the time budget from legitimate to illegitimate activities. This is the slope of the transformation curve in X_a, X_b space, where X_a and X_b stand for wealths in state A and B respectively. The right hand side represents the individual's marginal rate of substitution of wealth in

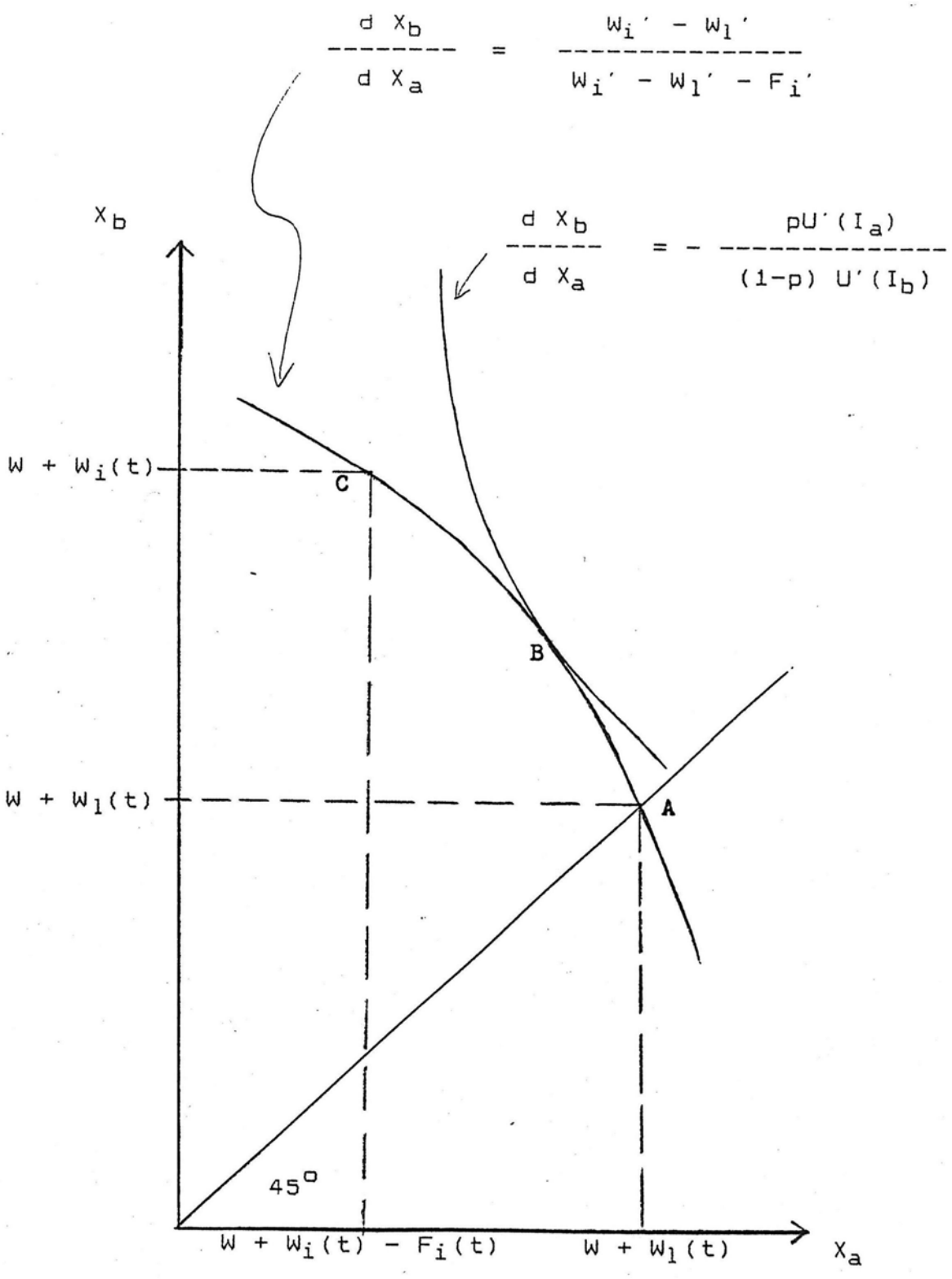


Figure 1 Optimal time allocation

state A , I_a, for wealth in state B, I_b. This is the slope of the indifference curve in X_a, X_b space.

The assumptions : W_i', W_l', $F_i' > 0$; W_i'', $W_l'' < 0$ and $F_i'' > 0$ ensure diminishing returns to both legitimate and illegitimate activities. The transformation curve in figure 1 is concave to the origin.

The optimal allocation of time can be represented by point B in figure 1 where the transformation curve represents different combination of payoffs in both states by altering the proportion of time in both activities.

If all time is spent in legitimate activities, $t_i = 0$, then $W_i(0) = 0$, $F_i(0) = 0$ and $I_a = I_b = W + W_l(\bar{t})$. In other words, if an individual is not involved in any criminal activity, his income would only depend on his initial wealth W and legitimate labour income $W_l(\bar{t})$. This is represented by point A in figure 1. In this case, the individual specializes in legitimate activity which is characterized by $X_a = X_b$ and point A would be on the 45^o line from the origin.

On the other hand, a full-time offender would have $t_l = 0$ or $t_i = \bar{t}$. Therefore, if he is caught, his income would be $I_a = W + W_i(\bar{t}) - F_i(\bar{t})$ otherwise $I_b = W + W_i(\bar{t})$. This is represented by point C in figure 1.

Notice that as an individual spends more time on legitimate activities, the equilibrium position (point B) would move closer to A and vice versa. His decision on this time-allocation model depends on his risk preference and the probability of being caught on the one hand and the returns

from both markets on the other.

His risk preference and probability of being caught are described by the right-hand side of equation (3) while the returns from both markets are described by the left-hand side of the equation. We can see that a steeper indifference curve and a flatter transformation curve would reduce one's time spending on the illegitimate market, t_i. In such a set-up, it is interesting to find out the condition which an individual just begins to participate in criminal activities. This would happen whenever the transformation curve is steeper than the indifference curve in figure 1. i.e.

$$\frac{W_i' - W_l'}{W_i' - W_l' - F_i'} > \frac{-p\,U'(X_a)}{(1-p)\,U'(X_b)}$$

At the margin, $X_a = X_b$. We rearrange the above inequality and obtain

$$W_i' - W_l' > p\,F_i'$$

This implies that an individual would begin his criminal career when the marginal legitimate return over the marginal illegitimate return is greater than the expected costs of punishment.

Since $p F_i' > 0$, we have $W_i' > W_1'$, otherwise the individual would have no incentive to engage in crime. In the following paragraphs, we derive some theoretical implications by altering the exogeneous variables in our simple time allocation model.

2.1.1 Theoretical Implications for Offenders' Reaction

(i) An increase in the probability of punishment

Since a larger p does not alter the income when either state occurs, the transformation curve is thus not affected. However, it increases the probability of an unfavourable state (being caught) to occur. The indifference curve becomes steeper. The equilibrium point would move closer to the 45^{o} line so that lesser time would be spent on illegitimate activities.

(ii) A more severe punishment

A marginal increase in punishment further reduces the payoff if an unfavourable state (being caught) occurs. Therefore, the transformation curve becomes flatter. In other words, the additional time allocated for illegitimate activities would produce less wealth (X_a) once the unfavourable state (being caught) occurs. Point A remains at its original position because it represents no criminal activity involvement and the severity of punishment would have no effect on such a person.

However, a severe punishment affects one's marginal rate of substitution between wealth in state A for wealth in state B as well. It reduces the income if an unfavourable state occurs, i.e. I_a declines. Assuming risk averse

behaviour, a larger $U'(I_a)$ increases the marginal rate of substitution between wealth in both states. This gives a steeper indifference curve which reduces the time allocated for illegitimate activities t_i. In short, a severe punishment reduces the time allocated for illegitimate activities through a flatter transformation curve and a steeper indifference curve. For risk-loving behaviour, $U'(I_a)$ decreases and the indifference curve becomes flatter. The overall effect is uncertain. The relationship between risk preference and the slope of utility function can be found in Green.[13]

(iii) An increase in illegitimate rewards

A better illegitimate reward $W_i(t_i)$ increases the payoff for any level of non-zero t_i. Point A should not be affected for the same reason mentioned already. Therefore, we would have a steeper transformation curve pivoted at A and this tends to increase t_i. However, I_a and I_b also increase and both $U'(I_a)$ and $U'(I_b)$ would increase. However, whether $U'(I_a)$ / $U'(I_b)$ would increase or not is uncertain. Therefore, the overall effect is ambiguous.

The ambiguity is the result of the opposing income and substitution effects. More illegitimate opportunities (an exogeneous increase in $W_i(t_i)$) make the criminal prospect more attractive but it also allows one to spend less time on illegitimate activities in achieving one's goal. Our model does not resolve this problem.

However, let us assume a dominant substitution effect in this aspect. This means, other things unchanged, better

illegitimate opportunities increases one's time allocation on criminal activities.

(iv) Better legitimate reward

The analysis is similar as in (iii) but now the transformation curve pivots outward at point C. A better legitimate prospect would induce people to work more. This will increase t_l. However, it is also possible that they may be rich enough to work less. Given a fixed amount of disposable time $\bar{t}$, a decrease in t_l means a corresponding increase in t_i. Once again, we assume the substitution effect is dominant. Therefore, a better legitimate reward would encourage an individual to work more.

(v) Previous empirical analysis

The supply of crime has been estimated by using cross-sectional data for various states in U.S.A.. Ehrlich used Ordinary Least Squares (OLS) method for estimating the 1940 and 1950 criminal supply function. OLS, two-stage least squares and seemingly unrelated regression were employed for estimating the supply function in 1960. Besides Ehrlich's paper, a detailed analysis as well as an early literature review can also be found in Anderson. [14] A more contemporary review on various theoretical set-ups and empirical models could be found in Schmidt (1984)[15]. In Schmidt, part I of it includes statistical analysis of criminal recidivism. Part II reviews economic models of criminal behaviour in which Ehrlich's and Becker's analyses are also included. Part III estimates long-run and short-run cost functions for large-scale prisons.

2.2 Bartel's Model on Women and Crime

In the foregoing analysis, a person's disposable time is assumed to be spent on legitimate and illegitimate activities only. Ann P. Bartel argued that we could follow the same analysis but dividing the disposable time for non-market and market activities[16]. The latter is subdivided into legitimate and illegitimate activities. Non-market activities include shopping, taking care of babies, etc. By doing so, a person's family background becomes an important factor of his criminal participation. Since men and women play different roles in the family, certain family characteristics may affect one's spouse and not the other. A person's given amount of disposable time is now divided among three activities : legitimate, illegitimate and non-market activities.

In general, the implications derived in her paper are ambiguous. For example, the author argued that since a married woman works intermittently throughout her lifetime, she would obtain lower wage rate in comparison with an unmarried woman. Therefore, given a fixed amount of disposable time on market activities, a married woman would then spend a greater proportion of her time on illegitimate activities. The question is that a married woman may also spend more time on household activities (i.e. non-market activities) than a single woman, such a scale effect reduces time allocation on market activities as a whole (on both illegitimate and legitimate activities). Thus, the

effect of low legitimate returns on a married woman's criminal participation behaviour is uncertain.

Also, if a high female labour force participation rate is caused by a low price of time at home. We expect a positive scale effect on both legitimate and illegitimate activities. However, since we do not have perfect information on female legal wage rate. The high female labour force participation rate can also be caused by a high legal wage rate which produces a substitution effect towards less time allocation in illegitimate activities. The ambiguity has to be settled empirically.

2.3 Wolpin's economic model of crime

Both Ehrlich's and Bartel's empirical models were based on cross-sectional data. Kenneth I. Wolpin has used annual English data over the past 80 years for testing[17]. In addition, he decomposed the single probability of apprehension and punishment into a number of deterrence probabilities, namely : clearance rate, conviction rate, imprisonment rate and fine rate. This is also the model we are going to use.

An individual is assumed to maximize the following expected utility function with four possible states. First, he is not detected. Second, he is caught and sent to prison. Third, he is caught and fined. Fourth, he is caught but set free at the end. The symbols are defined in table 2.

$$EU = (1-P_1)U(Y) + P_1P_2U(Y-C-L) + P_1P_3U(Y-C-F) + P_1(1-P_2-P_3)U(Y-C)$$

If we differentiate the expected utility function with respect to the three probabilities P_1, P_2, P_3, we have

$$\frac{\partial EU}{\partial P_1} = -U(Y) + P_2\,U(Y-C-L) + P_3\,U(Y-C-F) + (1-P_2-P_3)U(Y-C)$$

$$\frac{\partial EU}{\partial P_2} = P_1\,U(Y-C-L) - P_1\,U(Y-C)$$

$$\frac{\partial EU}{\partial P_3} = P_1\,U(Y-C-F) - P_1\,U(Y-C)$$

Table 2

Definitions 1

P_1	Detection rate
P_2	Imprisonment rate given prosecuted
P_3	Fine rate given prosecuted
Y	Total wealth if one is not caught
C	Cost of trial
L	Imprisonment cost in monetary equivalent (psychic cost included)
F	monetary fine

Let us define the various elasticities as follows :

$$n_1 = - \frac{\partial EU}{\partial P_1} \frac{P_1}{EU}$$

$$n_2 = - \frac{\partial EU}{\partial P_2} \frac{P_2}{EU}$$

$$n_3 = - \frac{\partial EU}{\partial P_3} \frac{P_3}{EU}$$

$$n_1 - (n_2 + n_3) = \frac{P_1}{EU} \{ U(Y) - U(Y-C) \} > 0$$

$$n_1 > n_2 + n_3$$

In other words, the elasticity of the detection rate is greater than the sum of the corresponding elasticities of the imprisonment and the fine rates.

Our empirical models would study two broad types of crime : offences against property and offences against the person. We have to classify various types of offences in this way because the data from the Correctional Services Department are categorized in such a manner. Offences against property include : robbery with firearms, other robberies, aggravated burglary, blackmail, arson, burglary with breaking, burglary without breaking, theft (snatching), theft (pickpocketing), theft (shoptheft),

theft from vehicle, taking conveyance without authority, abstracting of electricity, theft from construction site, theft of bicycle, other miscellaneous thefts, handling stolen goods, deception, business fraud, going equipped for stealing, possession of unlawful instrument and tampering with vehicles. Offences against the person include : murder and manslaughter, attempted murder, woundings, serious assaults, kidnapping, cruelty to child, criminal intimidation, abortion and other offences against person. First, we would apply ordinary least square method to estimate a crime rate equation. Second, a t-test would be carried out on each regression coefficient. Third, a F-test on the joint hypothesis that all coefficients of the deterrence variables are zero would follow. Fourth, the elasticities ordering (i.e. $n_1 > n_2 + n_3$) would be tested.

Ehrlich argued that the probability of being apprehended and convicted and imprisoned would be affected by the activity level of criminal justice system (e.g. police force) which is in part determined by the existing crime rate. Therefore, he estimated a simultaneous equations system to determine the supply function of crime. The probability of apprehension and imprisonment is determined in turn by the crime rate and various departmental expenditures. However, Wolphin's results with English data show that there is little difference between an ordinary least square and two-stage least square estimation of the

crime rate. In our model, only a single equation is estimated in which all the deterrence probabilities are assumed to be exogeneous, but the simultaneity issue would also be addressed.

2.4 The Empirical Model

To test the hypotheses of the economic model, the offence rate against property at time t (OAP_t) is assumed to be generated by the following process :

$$(1a) \quad OAP_t = A\,(DETECT)_t^{b_1}\,(PRISON)_t^{b_2}\,(FINE)_t^{b_3}\,(LI)_t^{b_4}\,(E)_t^{b_5}\,e^{u_t}$$

where A is a constant. DETECT, PRISON, FINE are the detection, imprisonment and fine rates ; LI is the length of imprisonment in months. This is the group of deterrence variables. E represents a number of environmental variables summarized in table 3 and u_t is the stochastic component. Although the economic model is founded upon an individual level, the absence of data at micro-level forced us to estimate the supply function at the aggregate level.

DETECT, PRISON and FINE measure how likely an offender will be caught, imprisoned, and fined. In general, these three ratios measure how likely an unfavourable state occurs. Notice that the detection rate (DETECT) is the ratio of cases detected (property crimes) to cases reported. The ideal proxy should be the number of offenders caught out of the total. However, the pool of offenders could never be known and we have to rely on the ratio measured in terms of cases rather than offenders.

In an Ehrlich's article (1977c,pp.218-19), he argued that the magnitude of the errors in data were thought to be proportional to the level of reported crimes. That is, the magnitude of underreported and misreported crimes are dependent of the level of reported crimes. In addition, as the crime rate is getting smaller, law-enforcing agents would have to pay more effort to lower the rate . In fact, it is rare for a country, even with extremely severe punishment, to have zero crime rate. Therefore, a functional form which allows a diminshing marginal deterrent effect is preferred. After transformation, the multiplicative functional form becomes a log-linear form which would be used for empirical estimation. The coefficients for various independent variables becomes their corresponding elasticities.

According to the Royal Hong Kong Police Force. A crime is ` detected ' when : i. a suspect is arrested and charged with the offence ; or ii. the offender admits the offence and the offence is ` taken into consideration ' by the court ; or iii. the offender has died, or has been committed to a mental hospital before proceedings are instituted ; or iv. the (juvenile) offender admits the offence but the police exercise discretion not to prosecute. In cases where an offence obviously been committed by several people but only one is arrested and charged, the crime is regarded as 'detected'. Also, if a suspect is prosecuted for an offence, it is classified as 'detected' even if he is later acquitted, or if for any reason the prosecution is not

proceeded with.

The severity of punishment LI is the median length of imprisonment (in months) for property crimes. The data have been grouped under broad headings (such as offences property, offences against morality, offences against the person, etc.) and the data on punishment for a specific type of offence are unavailable. However, if we assume that different types of property crimes are substitutable to a large extent, the median length of imprisonment should reflect the severity of punishment. Moreover, information on the amount of fine is not available, the length of imprisonment LI should reflect the severity of punishment in the year. There was one study made in 1979 about the juvenile attitudes towards punishment. The conclusion was "... the young offenders view all punishments primarily in in terms of severity to the exclusion of the other other dimensions such as rehabilitation and deterrence... "[18]. However, our economic model assumes that punishment should exhibit deterrent effect on a potential offender's decision to participate in criminal activities.

The environmental variables included are female labour force participation rate, male unemployment rate, number of retail establishments per 1000 population and real median income of production workers. The reasons for choosing the above variables are as follows. As the number of working women increases, they have more opportunity to have access to valuables not belonging to them. For instance, a cashier

Table 3

Symbols for the Empirical Model

OAP offence rate against property

= cases reported / population ('000)

PERSON offence rate against the person

= cases reported / population ('000)

Deterrence variables include :

DETECT detection rate (%)

= cases detected / cases reported

PRISON imprisonment rate given prosecuted

$$\frac{\text{no. of offenders imprisoned}}{\text{no. of offenders prosecuted}} * 100\ \%$$

FINE fine rate given prosecuted

$$\frac{\text{no. of offenders fined}}{\text{no. of offenders prosecuted}} * 100\ \%$$

LI median length of imprisonment in months

Environmental variables E include :

FLFP female labour force participation rate (30 - 39 years old)

MUNE male unemployment rate (20 - 29 years old)

RETAIL no. of establishments in the retail trades

INCOME real median monthly income from production and related workers, transport equipment operators and labourers.

D1, D2 and D3 dummy variables of 1 for the first, the second and the third quarter, zero otherwise.

* detailed description of variables in Appendix 7

has more opportunities to steal money than a housewife. This is analogous to the Opportunity Theory suggested by sociologists. A higher female labour force participation rate implies that there are more illegitimate opportunities available to women, but whether they have made used of them should be tested empirically. The choice of women aged 30-39 years old is suitable because a woman at this age is likely to be making decisions on child bearing. This is a major factor which affects her labour force participation decision. Thus, more variation in the participation rate is expected for this age group of women.

The second environmental variable chosen is the male unemployment rate. The possible relationship of unemployment and crime has been recognised long ago by sociologists.[19] Until 1963, Belton M. Fleisher[20] used the American data to test the effect of unemployment on juvenile delinquency. The result was positive. His empirical model on juvenile delinquency is one of the pioneering works in the economic analysis of crime. A positive relationship is expected between the crime rate and the unemployment rate because if one is unable to get a job, committing crime would become more attractive since he has nothing to lose in terms of labour earnings. Based on prisoners' characteristics, male aged 20 - 29 constitutes the largest group of prisoners. With reference to the labour market, this group of people are relatively less skilled. They are also less attached to their jobs probably because they are less likely to be

breadwinners than men in the 30s or 40s. Therefore, the unemployment rate for men aged 20 to 29 is chosen as an explanatory variable of the crime rate.

To measure the return from illegitimate activities, we use the number of retail establishments per 1000 population. Since most of the property crimes committed are shoplifting, thefts and burglary ,the number of retail establishments is intended to measure the opportunities to steal. The choice of variable is controversial. There are authors who have used average household income[21] permanent income[22], number of vehicles per 1000 population[23], etc. This is possible because certain types of property crimes (e.g. stealing vehicles in America) are popular in one country but not in others.

From the Annual Statistical Tables (1975 to 87) of the Correctional Services Department, we can easily observe that the majority of prisoners were men. Moreover, about half the male prisoners were manufacturing and production workers when they were caught for either property crimes or crimes against the person as shown in table 4. Their jobs require less skill or education and certainly provide less reward. To measure the legitimate return , the real median monthly income of production workers is therefore used.

Table 4

Proportion of craftsmen, production workers and labourers among male prisoners

	against property	against the person
1975	0.48	0.43
1976	0.47	0.50
1977	0.54	0.56
1978	0.54	0.59
1979	0.45	0.41
1980	0.43	0.46
1981	0.53	0.52
1982	0.50	0.60
1983	0.44	0.45
1984	0.50	0.46
1985	0.40	0.38
1986	0.47	0.47
1987	0.41	0.47

Source : Annual Statistical Tables, 1975 - 1987 , the Correctional Services Department

The above is the basic structure of our empirical model. Since men and women traditionally take up different roles in our society. The model could be modified somewhat to test the effects of economic variables which affect men and women specifically. To avoid complication at this stage, this part is left until equation (1a) is tested empirically.

Although the environmental variables (e.g. female labour force participation rate, male unemployment rate , real wage, etc.) are conceptually important factors affecting one's decision about stealing and other types of property crimes, we would like to apply the same model for offences against the person as well. Since these crimes are sometimes " by-products " of property crimes (e.g. a shopkeeper was stabbed when he discovered the burglar in the scene). If this is so, the factors affecting the property crime rate would also be those affecting crime rate against the person. How good are the arguments of the property crimes applicable here is uncertain at this moment. Therefore, we would employ the same structure as equation (1a) to estimate the corresponding supply function of crimes against the person. Of course, the deterrence factors, namely: DETECT, PRISON, FINE and LI are those counterparts of offences against the person.

$$(2a)\quad PERSON_t = B\,(DETECT)_t^{b_1}\,(PRISON)_t^{b_2}\,(FINE)_t^{b_3}\,(LI)_t^{b_4}\,(E)_t^{b_5}\,e^{v_t}$$

B is a constant and v_t is the stochastic component.

Chapter 3

Empirical Results

We first present the results of the overall offence rates against property and against the person. We employ cases reported per 1000 population as a measure for the crime rates. Afterwards, we would modify the model a bit for male and female crime rates on both offences against property and the person.

Due to data limitations, we have to resort to quarterly data which began from the third quarter of 1975 until the end of 1987. (1988 Statistical Tables from the Correctional Services Department was not available at the time of this research). The supply function for the offence rate against property (1a) and against the person (2a) are estimated by ordinary least squares method. The results are tabulated in table 5 (column 1 for the property crime rate and column 2 for the offence rate against the person).

3.1 Offences against property and the person

We first discuss the empirical results for the offences against property (1a) (Table 5, column 1) . All variables are in logarithmic values. Although some variables are insignificant, most of them have the expected sign and the adjusted coefficient of determination is quite high (R^2 = 0.762). The significant PRISON and FINE coefficients indicate that the higher the chance of imprisonment and fine, the lower would be the property crime rate. The severity of punishment LI, measured by the length of

Table 5

Log linear functional form for offence rates against property and the person
(N = 50)

	Against property (1a)	Against the person (2a)
constant	-0.920 (-0.41)	-3.200 (-1.49)
DETECT	-0.168 (-0.98)	-0.067 (-0.25)
PRISON	-0.210 * (-2.75)	-0.126 * (-2.11)
FINE	-0.118 * (-2.60)	-0.009 (0.36)
LI	-0.192 * (-2.25)	-0.003 (-0.08)
FLFP	0.930 * (3.53)	-0.162 (-0.91)
MUNE	0.255 * (4.37)	0.044 (0.68)
RETAIL	-0.043 (-0.09)	0.709 * (1.97)
INCOME	-0.043 (-0.23)	0.251 * (2.28)
D1	-0.002 (-0.08)	-0.090 * (-3.76)
D2	0.037 (1.31)	0.033 (1.44)
D3	-0.040 (-1.45)	0.076 * (3.42)
adj R^2	0.762	0.822
DW	2.37	1.75

T-values are in brackets.

imprisonment, also has its expected effect. Detection rate DETECT has the expected negative coefficient though insignificant. The insignificance of DETECT on the crime rate can be explained in several ways.

Firstly, the crime rate need not be reduced by an increase in detection rate, the mere presence of policemen may be good enough to deter crime. In such a case, the relationship between the crime rate and the detection rate would be very weak. Also, a larger number of police reporting centres facilitate victims' reporting. Assume the police force is able to detect a certain number of cases with the available resource, the higher reporting rate implies a decline in the overall detection rate even though the police force remains efficient. Both explanations suggest a more complicated relationship between crime rate and detection rate than we have claimed in our theoretical model.

The two measures on illegitimate return (RETAIL) and legitimate (INCOME) return of a potential offender have insignificant coefficients. This result is not unexpected because we could never know how much an offender could have earned if he had not broken the law, i.e. his alternative legitimate return. A good measure of illegitimate opportunities or returns is difficult to find as well. Different proxies have been used in various papers, including average household income, permanent income, number of motor vehicles registered per 1000 population, etc. In

most cases, there exists a positive relationship. However, most of these empirical tests are based on cross-sectional but not time series data.

The two significant environmental variables included in the model is female labour force participation rate and male unemployment rate. If the female labour force participation rate reflects the relative price of a woman staying at home, a high participation rate implies that women spend more time in market activities and therefore more time allocated to both legitimate and illegitimate activities.

Another argument for the positive relationship between the female labour force participation and crime rates is that juvenile offenders usually came from family with working mothers. The lack of parental care, especially the mother's supervision, increases the chance for youngsters going astray. Therefore, the female labour force participation rate may partly reflect the poor care and the subsequent wrongdoings of youngsters. If this is the case, FLFP is capturing both female and juvenile criminal participation behaviour. In addition to FLFP, the participation rate for women aged 20 to 29 has also been included as an explanatory variable but the t-value for this variable is extremely small.

Not only has shoplifting become the most popular female property crime, the age of women prosecuted for such an offence has been increasing. We can see in table 6 that the percentages of female prosecuted in the age group below 16, 16-20 and 21-30 are declining, while the corresponding

Table 6

Number and percentage of women prosecuted at various age groups

Year \ Age	< 16	16-20	21-30	31-60	>60	Total
1982	88 (10.0)	174 (19.8)	316 (35.9)	350 (39.8)	39 (4.4)	879 (100)
1983	130 (10.8)	254 (21.2)	430 (35.8)	473 (39.4)	43 (3.6)	1200 (100)
1984	81 (6.5)	224 (18.0)	467 (37.4)	492 (39.5)	64 (5.1)	1247 (100)
1985	135 (6.9)	339 (17.4)	657 (33.6)	851 (43.6)	106 (5.4)	1953 (100)
1986	81 (4.2)	300 (15.4)	650 (33.4)	878 (45.0)	121 (6.2)	1949 (100)
1987	104 (5.4)	247 (12.8)	639 (33.1)	926 (48.0)	117 (6.1)	1929 (100)

The corresponding percentage are shown in brackets.

Source : Royal Hong Kong Police Review, 1982 - 1987 issues.

figures for the age group 31 - 60 and above 60 are climbing. Note also that women in their 20s and 30s are likely to cover a large portion of those prosecuted for the offences.

The positive effect of male unemployment rate on property crime rate is expected. When a person is unsuccessful in the legitimate market, he may turn to the illegitimate one. Certainly, we are not saying that an unemployed person must become a thief. The failure in legitimate market simply makes the prospect of illegitimate activities more attractive.

The economic model of crime also makes a distinction between incapacitation and deterrence of punishment. Incapacitation means a person does not commit crime because he is locked up in jail. If this is so, the negative relationship between the crime rate and various probabilities is no longer the result of a potential offender's reaction towards incentive. To argue that offenders do react to incentives, we should consider the negative and significant elasticity of the fine rate given prosecuted. The elasticity of -0.118 for FINE means that for every 1% increase of the fine rate, the property crime rate would be reduced by 0.118%. Since fines should have no incapacitative effect, any retarding effect of fine should then be deterrent in nature. In other words, potential offenders find it less attractive to commit crime because of the corresponding high chance of being fined and not because of physical incapability to do so. Since we are using quarterly data, three dummy variables (D1, D2 and D3) are

included in our model in table 5 for both types of offences. The seasonal factors are insignificant to explain the property crime rate.

The F-value for the null hypothesis that all four deterrence variables (DETECT, PRISON, FINE and LI) are zero is 5.651. The hypothesis is rejected at both the 5% and 1% significance level. The restriction on the elasticities of detection, imprisonment and fine rates (i.e. $b_1 > b_2 + b_3$) is not supported (F = 0.88 ; accept the null hypothesis at the 5% significance level).

One of the criticisms[24] made about the economic models of criminal activities is the choice of logarithmic linear functional form which is used in this study. Here we also use the same set of data on a simple linear and a semi-log form to see if the relationship still holds. Simple linear form refers to using natural values of all variables in the regression ; semi-log form is the case with the dependent variable in logarithmic values. The results are shown in table 7 with equation (1a) reproduced for reference. We could see that different functional forms give us similar results.

If juvenile delinquency is an important component of today's criminal activities, we should include an additional variable to reflect its seriousness. In Agnes Ng's paper[25], she found that juvenile offenders usually quit school in Forms one or two. In terms of his time allocating decision, quitting from school imparts a positive scale effect on time

Table 7

Three functional forms
for offences against property
(N = 50)

	log linear form (1a)	simple linear form (1a)	semi-log form (1a)
constant	-0.920 (-0.41)	1.648 (1.17)	0.540 (1.01)
DETECT	-0.168 (-0.98)	-0.004 (-0.31)	-0.4E-03 (-0.99)
PRISON	-0.210 * (-2.75)	-0.040 * (-5.12)	-0.015 * (-5.04)
FINE	-0.118 * (-2.60)	-0.258 * (-2.16)	-0.099 * (-2.19)
LI	-0.192 * (-2.25)	-0.059 (-2.13)	-0.019 (-1.83)
FLFP	0.930 * (3.53)	0.044 * (2.82)	0.017 * (2.88)
MUNE	0.225 * (4.37)	0.188 * (3.60)	0.072 * (3.65)
RETAIL	-0.043 (-0.09)	0.047 (0.31)	0.005 (0.08)
INCOME	-0.043 (-0.23)	-0.3E-03 (-0.91)	-0.8E-04 (-0.57)
D1	-0.002 (-0.01)	-0.025 (-0.32)	-0.010 (-0.32)
D2	0.037 (1.31)	0.083 (1.07)	0.032 (1.10)
D3	-0.040 (-1.45)	-0.098 (-1.33)	-0.039 (-1.39)
adj R^2	0.762	0.758	0.754
DW	2.37	2.23	2.32

T-values are in brackets

Table 8

Offences against property
with and without the quit rate FM2 & D
(N = 50)

	Without FM2 & D	With FM2	With FM2 & D
constant	-0.920 (-0.41)	-2.660 (-0.90)	-3.300 (-0.92)
DETECT	-0.168 (-0.98)	-0.243 (-1.27)	-0.247 (-1.27)
PRISON	-0.210 * (-2.75)	-0.254 * (-2.79)	-0.236 * (-2.18)
FINE	-0.118 * (-2.60)	-0.129 * (-2.74)	-0.128 * (-2.68)
LI	-0.192 * (-2.25)	-0.184 * (-2.15)	-0.200 * (-2.02)
FLFP	0.930 * (3.53)	1.080 * (3.46)	1.112 * (3.36)
MUNE	0.255 * (4.37)	0.240 * (3.93)	0.240 * (3.89)
RETAIL	-0.043 (-0.09)	0.006 (0.01)	0.119 (0.20)
INCOME	-0.043 (-0.23)	0.104 (0.42)	0.135 (0.50)
FM2	-	0.202 (0.90)	0.225 (0.95)
D	-	-	0.018 (0.32)
D1	-0.002 (-0.08)	0.012 (0.36)	0.016 (0.45)
D2	0.037 (1.31)	0.045 (1.51)	0.045 (1.49)
D3	-0.040 (-1.45)	-0.034 (-1.20)	-0.033 (-1.15)
adj R^2	0.762	0.761	0.755
DW	2.37	2.46	2.48

available to be spent on other activities, including illegitimate ones. If this conjecture is true, the quit rate from school should exhibit a positive relationship with the overall crime rate through the contributory effect of juvenile delinquency.

An additional variable FM2[26], quit rate for Form 2 students, is included in equation (1a) (Table 8, column 2) for estimation. We can see that although FM2 turns out to be insignificant, the positive sign conforms to our expectation.

Although juvenile delinquency has drawn much attention nowadays, the problem may have been exaggerated. Prosecuted juveniles (aged under 16) occupy about 12% of all prosecuted for property crime. In table 9 , we have shown the percentage of prosecuted juveniles. The proportion has increased by a lot at the turn of the century and it attained 19.4% (not shown) in 1980. However, in most of the years, the percentage was around 12%. Juvenile delinquency occupies only a small portion of all crimes committed. Therefore, if the quit rate (FM2) has any effect on juvenile delinquency, a change in the trend of " adults " crime rate may easily overwhelm such effects.

In our introduction (chapter 1.1) , we have mentioned the sudden influx of illegal and legal immigrants from the mainland China before the abolition of the touch-base policy on October 1980. From time to time we hear about the criminal activities committed by them. An additional dummy

Table 9

Proportion of juvenile (aged below 16) prosecuted for property crimes

Year	1977	1979	1981	1983	1985	1987
% of prosecuted juvenile	11.9	16.4	17.2	12.5	11.3	12.1

variable (D) was introduced to see if the influx of immigrants during the period concerned contributed to the crime rate in a way different from our empirical setup --- perhaps they did not understand our legal system, did not accustom to the way of life, did not make friends , etc. Since the new immigrants may take some time to learn the illegitimate skills, we set a dummy of 1 for the period 1979 to 1981 (1981 was the first year after the abolition of touch base policy in 1980) and zero otherwise.

The empirical results in table 8 (column 3) show that although the dummy variable (D) has a positive sign, it is insignificant. There are two reasons for such an observation. Firstly, the influx of immigrants during the period 1979 to 1981 contributes little to the property crimes. Secondly, our model may have already reflected their behaviour. In other words, all the arguments on deterrence and the labour market are equally applicable to the new immigrants and these make the dummy variable redundant.

The second category of offences studied are those

against the person. We could see in table 5 (column 2) that only the imprisonment rate is a significant deterrence factor for crime rate against the person. The fact that female labour force participation rate has an insignificant effect on offence against the person is consistent with our observation because the criminal activities committed by women are usually non-violent (e.g. shoplifting). The insignificant effect of male unemployment rate shows that an unemployed person may use illegitimate means to acquire money but less likely to use violent ways. One possible reason for positive sign on RETAIL and INCOME is that if crimes against persons are " by-products " of property crimes, then good economic conditions which signal a higher potential illegal income may induce more violence being applied. This may be true even when the overall crime rate against property may be unrelated to such economic conditions.In addition, the crime rate is especially low in the first but high in the third quarter.

The F-value for the null hypothesis that all deterrence variables (DETECT, PRISON, FINE and LI) are equal zero is 1.723. The hypothesis cannot be rejected at both 5% and 1% significant level. The restrictions on the elasticities ordering of detection, imprisonment and fine rate is not supported in our model (F = 0.05 ; accept at the 5% significant level).

A logarithmic linear, simple linear and semi-log forms for estimation are shown in table 10. The results are similar.

Table 10

Three functional forms for
offence rate against the person
(N = 50)

	log linear form (2a)	simple linear form (2a)	semi-log form (2a)
constant	-3.200 (-1.49)	0.201 (0.75)	-1.427 (-1.87)
DETECT	-0.067 (-0.25)	-0.9E-03 (-0.57)	-0.003 (-0.58)
PRISON	-0.126 * (-2.11)	-0.006 * (-2.47)	-0.018 * (-2.60)
FINE	-0.009 (0.36)	0.012 (0.55)	0.025 (0.38)
ML	-0.003 (-0.08)	-0.4E-04 (-0.03)	-0.5E-03 (-0.13)
FLFP	-0.162 (-0.91)	-0.002 (-1.08)	-0.004 (-0.97)
MUNE	0.044 (0.68)	0.9E-03 (0.13)	0.005 (0.25)
RETAIL	0.709 * (1.97)	0.032 * (1.96)	0.081 (1.75)
INCOME	0.251 * (2.28)	0.5E-04 (1.90)	0.2E-03 * (2.01)
D1	-0.090 * (-3.76)	-0.031 * (-3.66)	-0.091 * (-3.84)
D2	0.033 (1.44)	0.010 (1.21)	0.031 (1.39)
D3	0.076 * (3.42)	0.028 * (3.59)	0.076 * (3.43)
adj R^2	0.822	0.820	0.823
DW	1.75	1.81	1.78

T-values are in brackets

3.1.1 The Simultaneity Issue

In the last section, the detection rate (DETECT) is insiginficant in explaining crime rates. Since the number of detected cases and the number of reported cases may be affected by the resource allocation to the police force as well as the crime rate itself, DETECT may be endogeneous. If this is so, estimating our model with a single equation would give biased coefficients. Let us assume that DETECT is determined by the crime rate, the number of policemen per 1000 population (POL) and the per capita real expenditure (POLEXP) of the Royal Hong Kong Police Force.

A two-stage least square estimation method is used but the detection rate remains insignificant. In addition, POL and POLEXP are used to predict DETECT which in turn becomes an instrumental variable in explaining the crime rate. By doing so, DETECT still remains insignificant. The empirical results are shown in Appendix 2.

For each regression, we have also included an one-period lag of the crime rate as an explanatory variable. However, this lag variable turns out to be insignificant in both equations.

3.2 Male Offence Rates against Property and the Person

Two additional environmental variables enter our model with respect to the crime rates committed by men and women. The first variable is the marital status and the second is the percentage of children aged 0 to 4. As mentioned before, Ann P. Bartel was the first person who employed cross-

sectional data in the United States to study female criminal participation rate.

In this study, we have to assume that the family structure of offenders is not systemmatically different from our population. Since the marriage decision is most likely to be made between the age of 25 to 34 , the marital status of the male population is measured by the percentage of married men aged 25 to 34 out of the total male population, MM2534M. In addition, the presence of children is measured by the percentage of children aged 0 to 4 out of the whole population.

The crime rate for men and women could not be measured by the cases reported per 1000 population because it may be difficult to know which cases are committed by men or women at the moment of reporting. Thus we approximate the male crime rate by the number of men prosecuted (aged 16 or above) divided by 1000 male population. The two dependent variables are MEN (referring to offence rate against property) and MALE (referring to offence rate against the person).

The detection rates DETECT for both offences are the same as before. Since we have no exact measure on the probability that a male offender is caught because the total number of male offenders is unknown. The detection rate, which is measured in terms of cases rather than persons, should be able to reflect how likely the offender (either male or female) would be caught by the police. The male imprisonment and fine rates are measured similarly as

before, but the relevant figures refer to male offenders specifically. The above mentioned variables are summarized in table 11.

The empirical results for offences against property and offences against the person committed by men are given in table 12. Notice that the crime rate is measured in terms of number of men prosecuted and not cases reported which has been done in the last section.

For the property crime rate (table 12, column 1), we could see that all the deterrence variables, namely DETECT, MPRISON, MFINE and ML, have the expected negative signs. However, only the probability of imprisonment (MPRISON) indicates a significant effect. Among the environmental variables, the male unemployment rate (MUNE) exhibits a positive effect on male crime rate as before. In addition, INCOME which is insignificant in the last section (though with expected sign) becomes significant now. INCOME is a measure of the legitimate earnings of a production worker. Committing crimes would be discouraged if an individual receives a higher real income legitimately. The marital status of men (MM2534M) does not have any significant effect on their criminal participation against property. However, the presence of young children (P04P) exhibits a marginally significant positive effect on the crime rate. This may be caused by the heavier family burden to breadwinners. The seasonal dummies (D1, D2 and D3) are all insignificant.

Table 11

Definitions 2

MALE male offence rate against the person

$$\frac{\text{no. of male prosecuted}}{\text{male population}} * 100\ \%$$

MEN male offence rate against property

$$\frac{\text{no. of male prosecuted}}{\text{male population}} * 100\ \%$$

ML median length of imprisonment for men in months

MM2534M percentage of married males aged 25 to 34

MFINE male fine rate given prosecuted

$$\frac{\text{no. of male offenders fined}}{\text{no. of men prosecuted}} * 100\ \%$$

MPRISON male imprisonment rate given prosecuted

$$\frac{\text{no. of male offenders imprisoned}}{\text{no. of men prosecuted}} * 100\ \%$$

(FEM , WOM , FL , MF2534F , FFINE and FPRISON are the corresponding variables of MALE, MEN , LI , MM2534M , MFINE and MPRISON for women)

MUEMPC male (aged 30 to 59) unemployment rate

MUNE male unemployment rate (as before)

P04P percentage of population aged 0 to 4

DETECT detection rate in percentage (as before)

INCOME real median monthly income for production workers (as before)

RETAIL no. of retail establishments per 1000 population (as before)

Table 12

Male offence rates
against property and the person
(N = 50)

	Against # property (1b)	Against the person (2b)
constant	-0.7E-03 (-0.01)	-4.723 (-1.11)
DETECT	-0.155 (-1.05)	0.244 (0.62)
MPRISON	-0.638 * (-6.76)	-0.278 * (-3.18)
MFINE	-0.011 (-0.32)	-0.003 (-0.08)
ML	-0.084 (-1.24)	-0.136 * (-2.25)
RETAIL	0.619 (1.81)	0.655 (1.45)
MUNE	0.181 * (3.09)	-0.050 (-0.63)
INCOME	-0.199 * (-2.04)	0.277 (1.28)
MM2534M	-0.029 (-0.09)	-0.560 (-0.84)
P04P	1.339 (1.94)	1.214 (1.63)
D1	-0.016 (-0.78)	-0.114 * (-2.54)
D2	-0.023 (-1.35)	-0.002 (-0.05)
D3	-0.023 (-1.60)	0.055 (1.76)
adj R^2	0.830	0.749
DW	1.30	1.38

T-values are in brackets
adjusted for the first order autocorrelation with p=0.48

The F-value of the null hypothesis that all four deterrence variables (DETECT, MPRISON, MFINE and ML) are zero is 13.79. The hypothesis is rejected at either the 5% or 1% significance level. The property crime rate estimated by a simple linear and a semi-log functional form can be found in Appendix 3.

With respect to offences against the person (Table 12, column 2), either an increase in the probability of imprisonment or length of sentence reduces the male crime rate against the person. The F-value of the null hypothesis that all four deterrence variables (DETECT, MPRISON, MFINE and ML) are zero is 3.08. The hypothesis is rejected at either the 5% or 1% significance level. The restriction on the elasticities of detection, imprisonment and fine rates is not supported in our model (F = 1.84). The results with simple linear and semi-log functional forms could be found in Appendix 4.

Since all the environmental variables are insignifcant, the regression equation is re-estimated by taking the group of deterrence variables and a seasonal dummy as explanatory variables. The result adjusted by the first order autocorrelation (p = 0.55) is :

$$\underset{}{MALE} = \underset{}{0.048} - \underset{(0.39)}{0.013}\ DETECT - \underset{(-8.38)}{0.461}^{*}\ MPRISON - \underset{(-1.95)}{0.066}^{*}\ MFINE$$

$$- \underset{(-2.08)}{0.109}^{*}\ ML - \underset{(-3.17)}{0.058}^{*}\ D1 + u$$

$R^2 = 0.803$; DW = 1.62

All the deterrence variables, except the detection rate, are significant in reducing crime rate. The coefficients of MPRISON is much greater than MFINE. This implies that imprisonment is more powerful than fine in this aspect.

3.3 Female Offence Rates against Property and the Person

Similar to the previous section, the female offence rate is measured by the number of women prosecuted (aged 16 or above) per 1000 female population.

The detection rate for crimes against property and the person are the same as those used in chapter 3.1 because there is uncertainty about the sex of the offender until he (or she) is apprehended. Notice that for those years with no woman fined, we set FFINE equals 0.000001 in order to make the log linear functional form operational.

In the regression, the male (aged 30 to 59) unemployment rate MUEMPC is used instead of the female unemployment rate. Since a woman works intermittently throughout her life, her being unemployed may be caused by a number of non-economic reasons and this may not indicate any financial difficulty in her family. On the contrary, men aged 30 to 59 are strongly attached to the labour market and their unemployment rate is more likely to reflect the true economic condition affecting one's (and his wife's,if any) decision on criminal participation. When we are studying the male offence rates in the last section, the males unemployment rate in the age group of 20 to 29 is chosen because they constitute the largest portion of the male

prisoners' population. However, the age of female prisoners is not concentrated at any particular range, therefore , an unemployment rate which reflects more general economic conditions is preferred. Secondly, the legitimate earning is now measured by SERV (real monthly income of a service worker) because the statistical figures indicate that the majority of the female prisoners were service workers when they were caught. In table 13, we can see that although this occupation is already the most popular type of activity, using SERV to approximate women's legitimate return has overlooked many others. For example, many of them are economically inactive or seeking jobs too[27].

This is in contrast to the choice of INCOME as the legitimate return for men where half of all male prisoners were production workers (Table 4). Education level is sometimes used to measure the wage rate of an individual. However, since we use quarterly data for 11 years only, little quarterly variation is expected in the education variable. The schooling variable is therefore abandoned.

We must admit that SERV is not a good measure of female offenders' labour earning. In a study of 67 young female offenders by the Prisons Department in 1980 (later it has become the Correctional Services Department), quite a large proportion of the girls (40.3%) were dance hostesses with 31.3% of them earning extra income by prostitution or drug peddling[28].

Table 13

Proportion of services, sports and recreation workers

	against property	against the person
1975	0.29	0.00
1976	0.24	0.06
1977	0.20	0.31
1978	0.34	0.42
1979	0.34	0.30
1980	0.40	0.16
1981	0.15	0.30
1982	0.12	0.20
1983	0.17	0.00
1984	0.23	0.14
1985	0.25	0.18
1986	0.25	0.18
1987	0.30	0.29

Source : Annual Statistical Tables, 1975 - 1987, Correctional Services Department.

Table 14

Female offence rates
against property and the person
in log linear form
(N = 50)

	against property (1c)	against the person (2c)
constant	6.185 (1.70)	-17.594 * (-3.56)
DETECT	0.701 * (3.07)	0.810 (1.88)
FPRISON	-0.103 (-1.36)	0.039 (0.60)
FFINE	0.008 (1.91)	0.001 (0.34)
FL	-0.218 * (-2.02)	-0.063 * (-2.41)
RETAIL	1.274 * (2.43)	1.320 * (2.04)
MUEMPC	0.136 * (2.23)	-0.038 (-0.47)
SERV	0.362 (1.27)	0.474 (1.64)
MF2534F	-1.790 * (-2.24)	1.256 (1.44)
P04P	-4.010 * (-3.74)	-0.229 (-0.23)
D1	-0.115 (-1.95)	-0.046 (-0.67)
D2	-0.094 * (-2.15)	0.069 (1.35)
D3	-0.044 (-1.23)	0.107 * (2.54)
adj R^2	0.964	0.585
DW	1.67	1.46

T-values are in brackets

Our economic model suggests that high detection, fine and imprisonment rates would bring a potential offender into unfavourable states of the world. In table 14 (column 1), the effect of the detection rate DETECT on the female property crime rates (1c) is significantly positive. This is paradoxical.

The variable measuring illegitimate opportunities RETAIL, which is the number of retail establishments per 1000 population, also exhibits a positive relationship with the female property crime rate.

One possible explanation is that the detection rate for shoplifting is very high, because once a shopkeeper realizes that a person is shoplifting, that person is very likely to be caught. Shoplifting is different from burglary in the way that there is almost no time lag between the crime being committed and the victim realizing his bad fortune.

This is confirmed by the data provided by the Royal Hong Kong Police Force (Table 15). As a consequence, it is likely that only detected crimes are reported in most cases.

Table 15

Detection Rate of Shoplifting

Year	1981	1982	1983	1984	1985	1986	1987
Detection Rate in %	96.0	97.1	97.8	96.8	97.0	95.5	93.9

Source : Royal Hong Kong Police Force Review, 1981 to 1987 issues.

The empirical results show that the length of imprisonment has an expected negative significant effect on the female property crime rate (Table 14, column 1). Since men aged 30 to 59 are usually strongly attached to the labour market, their being unemployed reflects poor economic conditions. Therefore, the positive significant MUEMPC is reasonable. The percentage of married women exhibits a a negative relationship, this may reflect their involvement in household activities. The presence of young children P04P has a scale effect in reducing a woman's time on both legitimate and illegitimate activities. This is reflected by a negative significant coefficient of the variable.

The F-value of the null hypothesis that all four deterrence variables (DETECT, FPRISON, FFINE and FL) are zero is 14.24. The null hypothesis is rejected at both the 5% and 1% significance levels.

Referring to the female offence rate against the person (2c) in table 14 (column 2). The length of imprisonment and the RETAIL gave us the expected significant sign. The family background, which is measured by MF2534F and P04P, has little effect on female crime rate against the person.

Among different types of female offences against the person committed, serious assaults have taken up over 80% from 1976 to 1986. This figure reached 90% in 1986 and declined to 67% in 1987. However, this is still the most popular crime committed by female offenders. If we believe that these serious assaults are directly or indirectly

related to property crimes, the positive effect of the number of retail establishments per 1000 population (RETAIL) on the female offence rate becomes clear.

The F-value for the null hypothesis that all four deterrence variables (DETECT, FPRISON , FFINE and FL) are zero is 3.243. The hypothesis is rejected at 5% but not the 1% significance level. The restrictions on the elasticities is not supported at the 5% or 1% level (F = 2.92).

Similar to previous analysis, two other functional forms, namely, simple linear and semi-log forms could be found in Appendices 5 and 6.

Chapter 4

Explaining Movements of Offence Rates

Based on the empirical results obtained in chapter 3, we can try to explain movements in the crime rate in terms of those deterrence and environmental variables employed in the study. Offences against property would be our first concern. Next, the movement of the crime rate against the person would be explained.

4.1 Property Crime Rate

Besides some fluctuation, the movement of property crime rate is quite clear. We would first look at the male property crime rate as measured by the number of men prosecuted per 1000 male population. Next, we would study the movements in female property crime rate and the overall crime rate as measured by the number of cases reported per 1000 population.

4.1.1 Male Property Crime Rate

As mentioned earlier, we do not know the offender's sex when a crime is reported. To measure the extent of male participation in illegitimate activities, one has to rely on the male prosecution rate. Figure 2 shows the rate graphically. The rise from 1978 to 1984 and the subsequent fall were mainly the result of the unemployment rate as shown on figure 3. In addition, during the rising period, the imprisonmenmt rate declined from 31% to 15% .

Figure 2

Male property crime rate(MEN)
(men prosecuted per 1000 male population)

MIN VALUE = 0.82279 MAX VALUE = 1.3233 SPACING = 0.0102

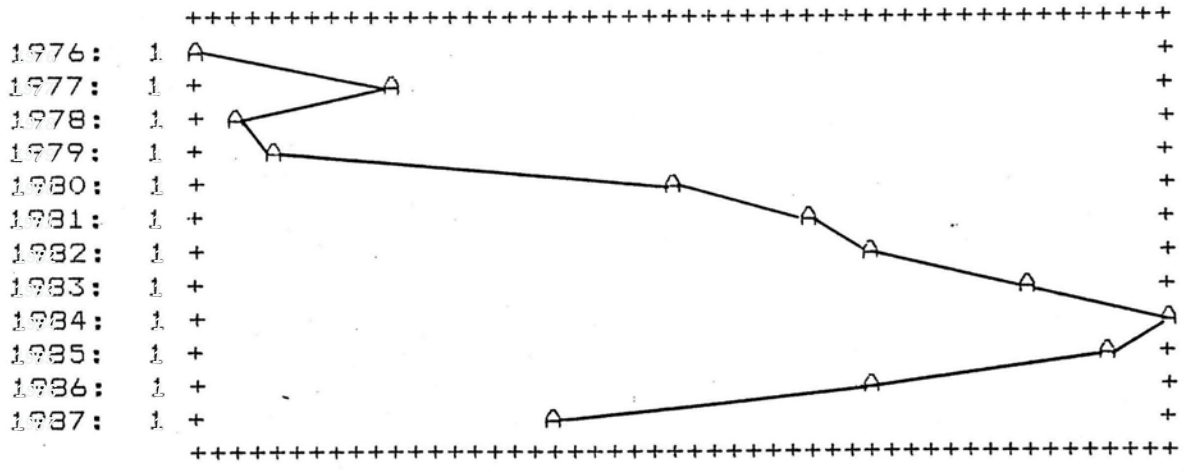
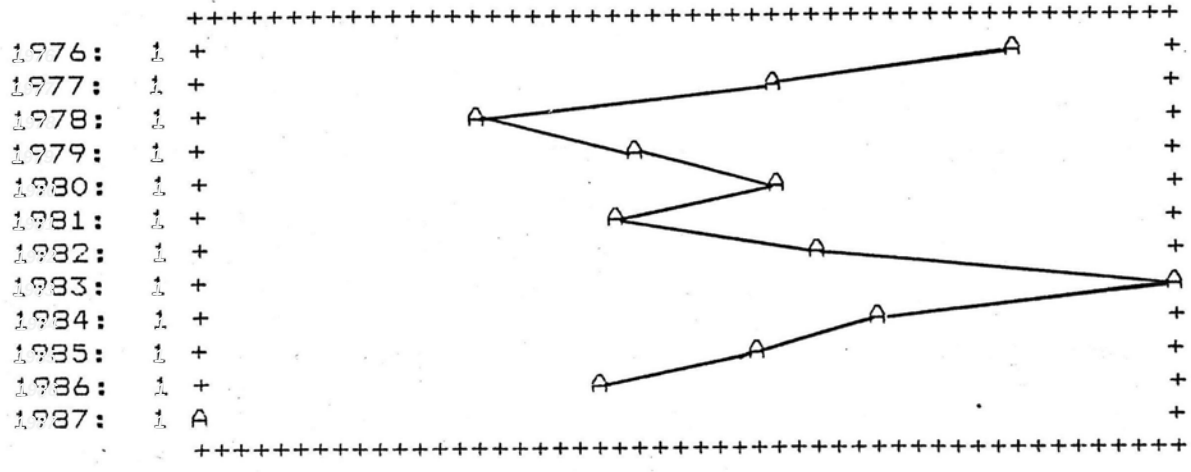


Figure 3

Male unemployment rate (MUNE)
(in %)

MAX VALUE = 1.9750 MIN VALUE = 5.5750 SPACING = 0.0735



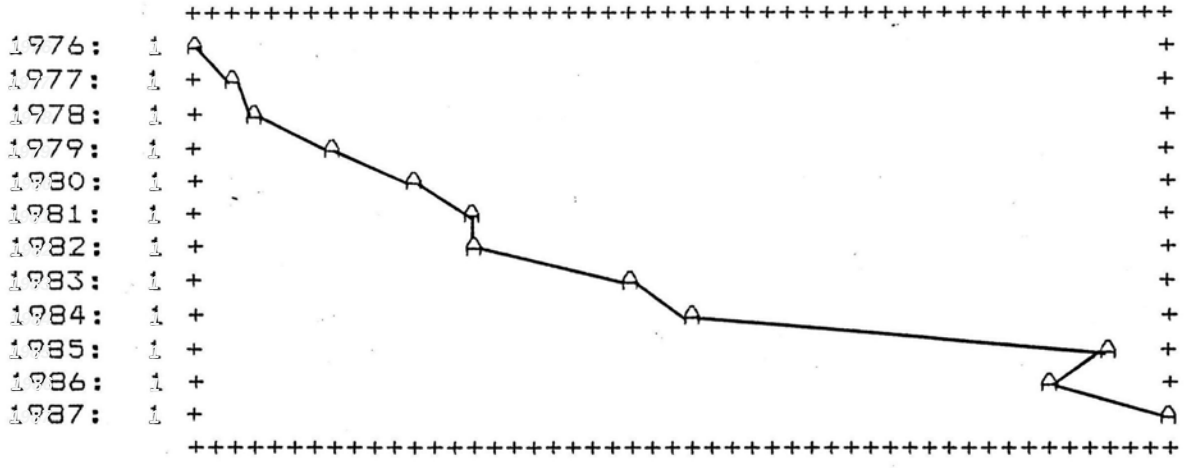
4.1.2 Female Property Crime Rate

The female property crime rate was clearly rising throughout the period, except for a small downturn in 1986.

Figure 4

Female property crime rate (WOM)
(women prosecuted per 1000 female population)

MIN VALUE = 0.0880 MAX VALUE = 0.26717 SPACING = 0.00366

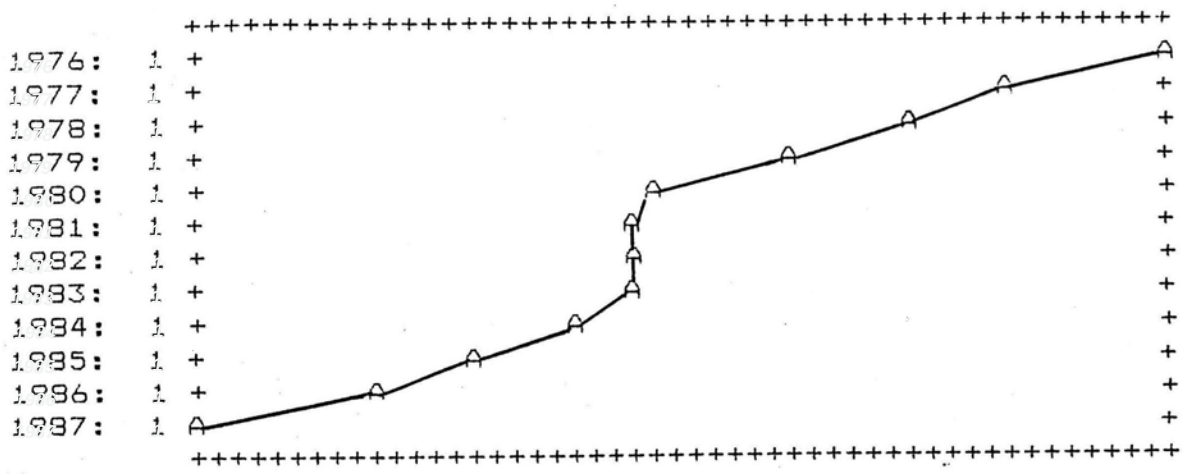


Since shoplifting has become the most popular female property crime, increasing number of retail establishments per capita is a factor. In addition, the percentage of children aged 0 to 4 has declined steadily from 9% in 1976 to only 7.2% in 1987. Couples having fewer children makes the wife less committed to her family. In our empirical model, the decline of P04P implies that a woman would have more time to spend in both legitimate and illegitimate activities.

Figure 5

Percentage of population aged 0 to 4 (P04P)

MIN VALUE = 7.230 MAX VALUE = 8.9676 SPACING = 0.03546



4.1.3 Overall Crime Rate

The movement is quite clear. The property crime rate rose from 1977 (2.29 cases per 1000 population) to 1983 (3.25 cases per 1000 population , figure 6). The property crime rate has grown by 42% per 1000 population. What has happened in these six years ? Since most offenders are men , the overall crime rate in figure 6 is similar to figure 2. The falling imprisonment rate and the rising unemployment rate are important factors.

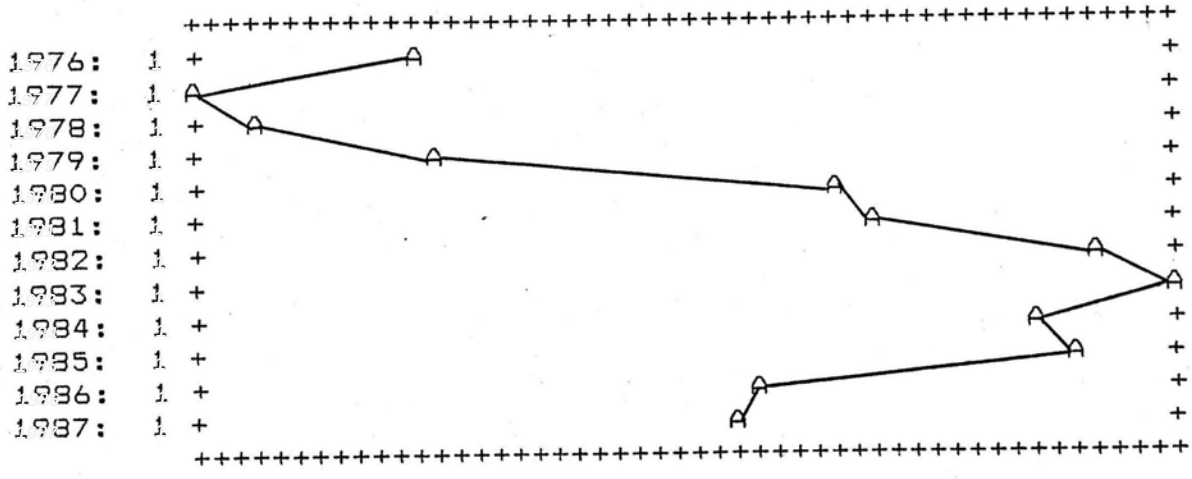
Among different types of property crimes, shoplifting is the one which has drawn considerable attention recently. Before 1982, the Royal Hong Kong Police Force Review had no such item explicitly in their Review. In 1982, the number of shoplifting cases reported was 2800. The corresponding

figure in 1987 reached 7077. In other words, shoplifting has been increasing at 25% on average annually. The average growth rates for men and women prosecuted for shoplifting were 13% and 24%, respectively. Shoplifting has become the most popular property offence committed by women. We believe that the low relative price at home for women is a reason for the upsurge of property crime rate. Although we cannot measure such a price directly, a lower price of time at home could be reflected by a high female labour force participation rate. In our empirical model, such a participation rate (which reflects the price at home) does provide a positive significant impact on the female property crime rate.

Figure 6

Overall property crime rate (OAP)
(cases reported per 1000 population)

MIN VALUE = 2.2911 MAX VALUE = 3.2452 SPACING = 0.0197



4.2 Crime Rate against the Person

The movement of crime rate against the person was unclear. Probably because the crimes against the person involve violence and are more serious than property crimes (e.g. theft), much attention has been paid in order to avoid any clear upsurge. Anyway, our model shows that the imprisonment rate and the severity of punishment seem to be promising in deterring crimes against the person.

In addition, the sex composition of men and women prosecuted is fairly stable over the last decade. The ratio is roughly 1 to 10, i.e. only one woman is prosecuted when every ten men are prosecuted. With respect to punishment in 1978, there were 368 men imprisoned while the corresponding number of women imprisoned was only seven.

4.2.1 Male crime rate against the person

In our study, we have tested the same model on crime data against the person. Most of the environmental variables turn out to be insignificant. Only the imprisonment rate and the length of imprisonment are shown to be significant in deterring offences against the person

From 1976 to 78, the number of men prosecuted increased by 14% (from 0.33 per thousand in 1976 to 0.38 per thousand in 1978) as shown in figure 7. This upsurge may be explained by the decline of the imprisonment rate accompanied by the decrease in the severity of punishment (figure 8 and 9). From 1978 to 1981, the male prosecution rate decreased by 3% on average annually. During this period, the imprisonment rate remained stable but the length

of sentence has been doubled from 5.8 to 10.4 months.

Figure 7

Male offence rate against the person (MALE)
(men prosecuted per 1000 male population)

MIN VALUE = 0.3322 MAX VALUE = 0.4507 SPACING = 0.0024

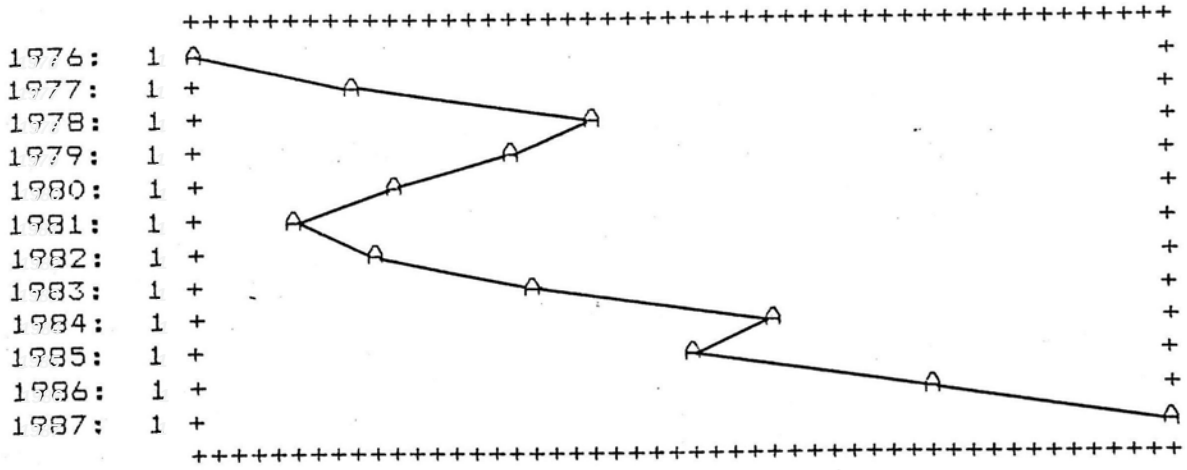


Figure 8

Male imprisonment rate (MPRISON)
(men imprisoned per men prosecuted in %)

MIN VALUE = 5.9438 MIN VALUE = 13.862 SPACING = 0.1646

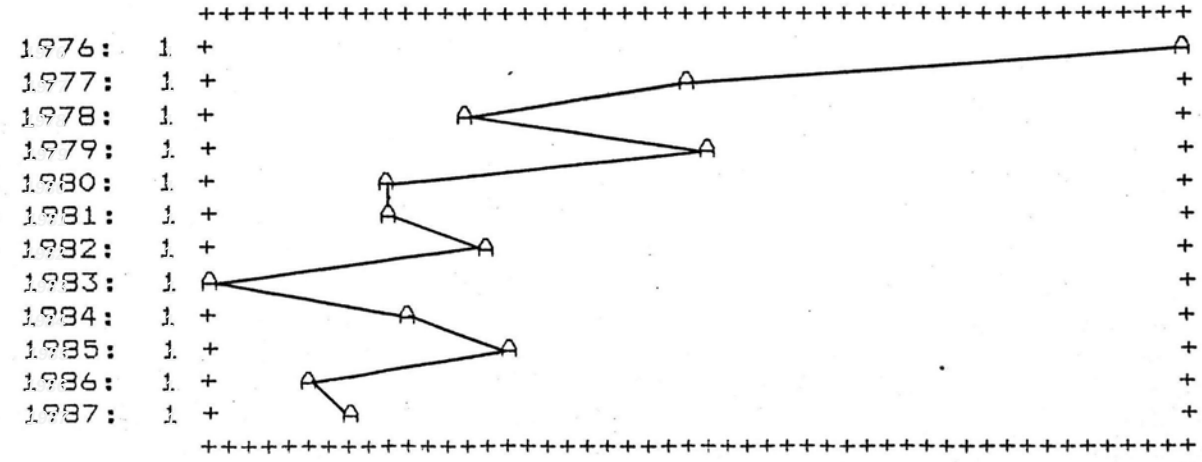
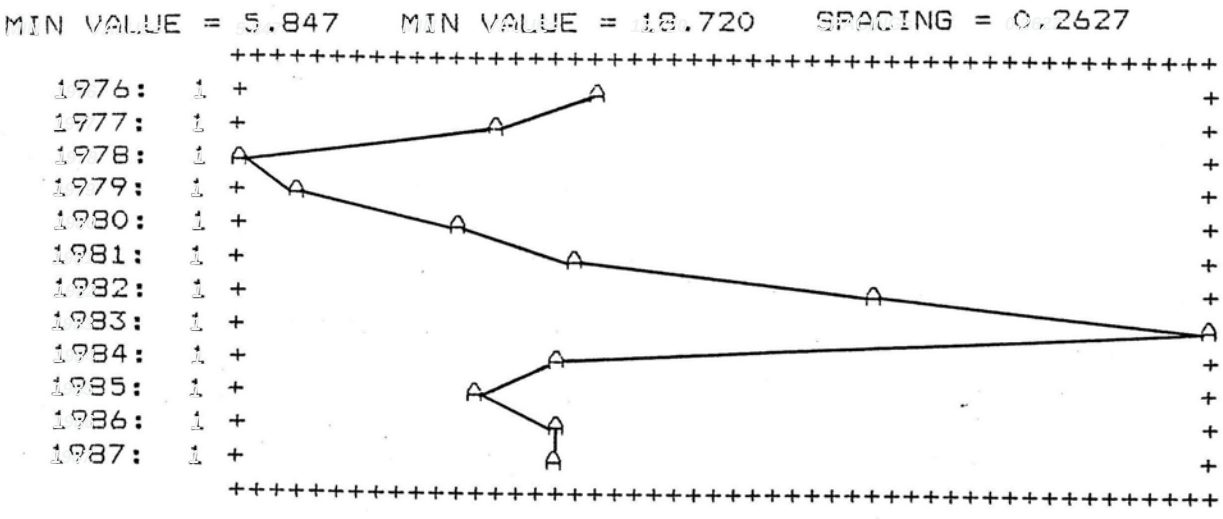


Figure 9

Median length of sentence (ML)
(in months)

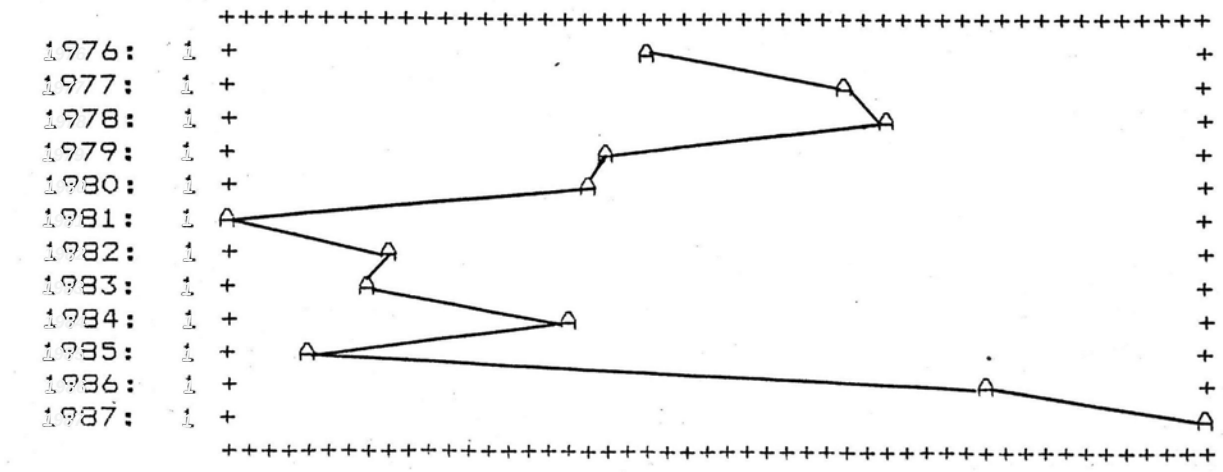


4.2.2 Female crime rate against the person

Although our economic model cannot explain the female crime rate against the person very well, the length of sentence seems to be an important factor. From 1978 to 1981, the crime rate has fallen by 20%. The median length of

Figure 10

Female offence against the person (FEM)
(women prosecuted per 1000 female population)



imprisonment has increased from 12 months in 1978 to 20 months in 1981.

The second upsurge occurred from 1985 to 1987. In this period, the crime rate has increased by 35%, while the median length of imprisonment decreased from 27 months to 5.6 months. It seems that the severity of imprisonment is a crucial deterrence factor for crimes against the person.

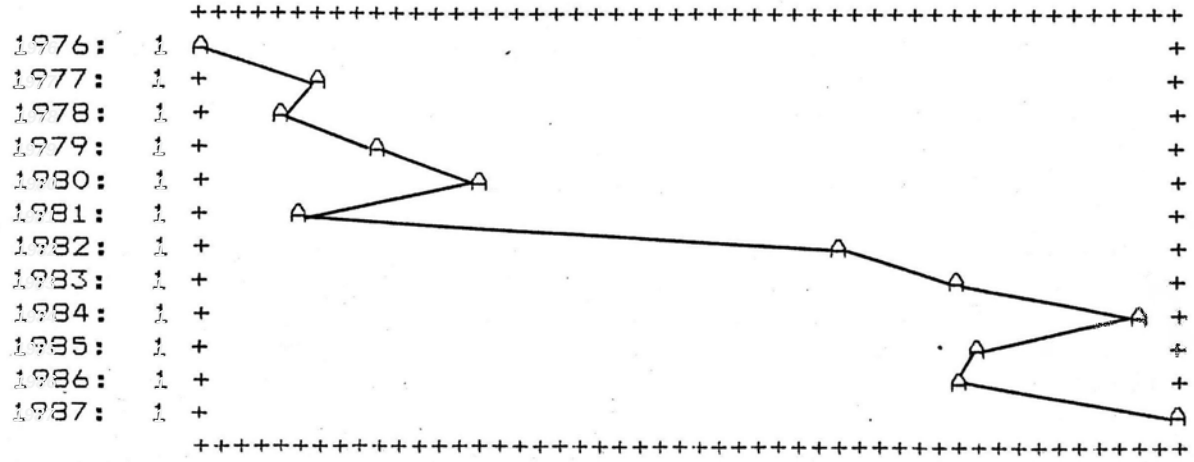
4.2.3 Overall Crime Rate against the Person

Instead of using the number of men and women being prosecuted, the crime rate against the person can be measured by the number of cases reported per 1000 population. From 1981 to 1984, an upward movement is observed because both male and female crime rates were climbing, figure 11. Although our economic model performs less well in explaining the crime rate against the person, it shows that a higher chance of receiving lengthy imprisonment is useful in suppressing the rate .

Figure 11

Overall offence rate against the person (PERSON)
(cases reported per 1000 population)

MIN VALUE = 0.3161 MAX VALUE = 0.4044 SPACING = 0.0018



Chapter 5

Conclusions

The outstanding features of the economic analysis of crime is the inclusion of probabilities and consequences of various states of the world which are usually neglected in sociological investigations of the subject. In the research, we have studied two broad categories of offences, namely : offences against property and against the person. The overall performance of our economic model is satisfactory, we are able to show a negative relationship between deterrence variables and the crime rate. However, the restriction on the elasticities cannot be verified.

The set of deterrence factors performs quite well in explaining the overall property crime rate. About 10% of the variation can be explained by the fine rate, the imprisonment rate and the length of sentence.

On the other hand, the set of environmental variables can explain 32% of the overall variation while the unemployment alone can explained about 9%.

However, our economic model seemed to perform less well with respect to the offences against the person. The labour market conditions do not affect the decision of committing crimes against the person very much. Only the high imprisonment rate and severity of punishment were promising in suppressing offences against the person.

The number of women prosecuted for crimes against the person was about 10% of the figure for men in 1987. This ratio remained quite stable throughout our study e.g. 10% in 1980 and 11% in 1976. This is in contrast to the growing number of women prosecuted in property crimes.

The above observation is understandable because offences against the person usually involve physical violence. Owing to the physical limitation of a woman, she is less likely to resort to violence . In contrast, shoplifting (the most popular female property crime) requires little physical strength and cost of entry. With growing opportunities available and leniency of our criminal justice system, the female property crime rate is expected to increase .

Footnote

1. Becker,G.S.(1968)," Crime and Punishment : an Economic Approach ", Journal of Political Economy, vol.76, no.2, pp.169-217.

2. G.S.Becker & W.Landes, Essays on the Economics of Crime and Punishment, 1974, Columbia University Press(NBER).

3. Hong Kong Annual Digest of Statistics, 1981 and 88 editions, Census and Statistics Department, Hong Kong.

4. Tony S.F.Pang, An Exploratory Study of the Relationship between the Adjustment Problems of New Immigrants from China and Crime in Hong Kong , Master of Social Work Thesis, May 1984.

5. L.Cohen & R.C.Land, Sociological Positivism & the Explanation of Criminology, Positive Criminology, sage publication, 1987, edited by M.R.Gottfredson & T.Hirshi.

6. Agnes Ng, Social Causes of Violent Crimes Among Young Offenders in Hong Kong , 1975, Social Research Centre, Hong Kong.

7. Report of the Working Group on Juvenile Crime (1981), Hong Kong Government.

8. Nelson W.S.Chow ,Alex Y.M.Tang & T.F.Chan, A Comparison of Delinquent Youth & Non-delinquent Youth on the Aspects of Partial Supervision & Schooling : A Follow-up Study on Unruly Youth in Tsuen Wan, Kwai Chung & Tsing Yi , Jan.1987.

9. H.Traver," Crime & Socio-Economic Change in Hong Kong", South Asian Journal of Social Science, 1980, Vol.8,nos 1-2.

10. G.S.Becker, "Crime & Punishment : An Economic Approach", Journal of Political Economy 78, no.2, March/April 1968, pp.526-36.

11. I.Ehrlich, Participation in Illegitimate Activities : An Economic Analysis , PhD. dissertation, Columbia University, 1970.

12. I. Ehrlich, " Participation in Illegitimate Activities : An Theoretical & Empirical Investigation ", Journal of Political Economy,May 1973, pp. 521-65.

13. H.A.J.Green, Consumer Theory, Macmillan Press , 1976, pp.226-9.

14. R.W.Anderson, The Economics of Crime, Macmillan Studies in Economics, 1976, pp. 9-21.

15. Peter Schmidt & Ann D. Witte, An Economic Analysis of Crime and Justice : Theory, Methods, & Applications, Academic Press Inc., 1984.

16. Ann P. Bartel, " Women & Crime : An Economic Analysis", XVII(1) Economic Inquiry,Jan. 1979, pp. 29-51.

17. K.I.Wolpin, " An Economic Analysis of Crime & Punishment in England & Wales, 1894-1967 ", Journal of Political Economy ,1978, vol. 86, no.5, pp.815-40.

18. Mildred McCoy & Erik Kvan, Attitudes Towards Punishment, Centre of Asian Studies, University of Hong Kong, 1979, p.70.

19. Hermann Mannheim, Crime and Unemployment, in W.C.Carson and Paul Wiles, (ed.), The Sociology of Crime and Delinquency in Britain, vol.1: the British Tradition, London: Robertson and Co.,Ltd., 1975, pp.44-52.

20. B.M.Fleisher, " The Effect of Unemployment on Juvenile Delinquency", Journal of Political Economy 73, Dec. 1963, pp. 543-55.

21. K.L.Avio & C.Scott Clark, " The supply of property offences in Ontario : evidence on the deterrent effect of punishment ", Canadian Journal of Economics XI, no. 1, Feb. 79, pp.1-19.

22. I.Ehrlich, " The Deterrent Effect of Capital Punishment : A Question of Life & Death ", The American Economic Review, June 1975, pp. 397-417.

23. S.Layson, " Homicide & Deterrence : another wiew of Canadian time-series evidence ", Canadian Journal of Economics, 16 Feb. 1983, pp.52-73.

24. W.J.Bowers & G.L.Pierre, " The Illusion of Deterrence in Isaac Ehrlich's research on Capital Punishment ", The Yale Law Journal, 1975, pp.187-206.

25. Agnes Ng, op. cit.

26. Please check the Appendix 7 for detailed definition of FM2.

27. We have contacted the Correctional Services Department for the exact definition of a service worker in the Annual Statistical Tables published. The response was that it mainly included restaurant waitress/waitors, sales, etc., without disclosing the exact types of jobs involved.

28. The Young Female Offenders, 1980, A Hong Kong Prisons Department Research Project.

Appendix 1

To show equation (3) represents a global maximum, we differentiate (2) for the second order condition. Assume W_i'', W_l'', $U''(I_a)$, $U''(I_b) < 0$ and $F_i'' > 0$

$$\frac{d^2EU(I)}{d\,t_i^2} = pU''(I_a)\,[W_i' - W_l' - F_i']^2 + pU'(I_a)\,[W_i'' + W_l'' - F_i''] + (1-p)U''(I_b)\,[W_i' - W_l']^2 + pU'(I_b)\,[W_i'' + W_l''] < 0$$

Appendix 2

Two-stage least squares on offence rates against property and the person
(N = 50)

	against property	against the person
constant	-3.020 (-0.96)	1.241 (0.33)
DETECT (predicted)	0.102 (0.23)	-0.877 (-1.34)
PRISON	-0.226 * (-2.03)	-0.097 * (-1.96)
FINE	-0.099 * (-2.20)	-0.008 (-0.33)
LI	-0.187 (-1.85)	-0.6E-03 (-0.01)
FLFP	1.018 * (3.55)	-0.191 (-1.11)
MUNE	0.285 * (5.50)	0.073 (1.89)
RETAIL	-0.093 (-0.18)	0.427 (1.10)
INCOME	-0.079 (0.45)	0.191 (1.68)
D1	-0.002 (-0.06)	-0.116 * (-3.87)
D2	0.040 (1.34)	0.029 (1.32)
D3	-0.041 (-1.41)	0.071 * (3.23)
adj R^2	0.743	0.830
DW	2.27	1.76

T-values are in brackets

Appendix 3

Male property crime rates estimated by simple linear and semi-log forms
(N = 50)

	simple linear form	semi-log form
constant	0.805 (0.85)	0.425 (0.42)
DETECT	-0.001 (-0.40)	0.1E-03 (0.03)
MPRISON	-0.025 * (-7.76)	-0.022 * (-6.59)
MFINE	-0.004 (-0.14)	-0.012 (-0.44)
ML	0.2E-03 (-0.03)	-0.002 (-0.20)
RETAIL	0.136 * (3.00)	0.115 * (2.39)
MUNE	0.033 * (1.94)	0.046 * (2.60)
INCOME	-0.5E-03 * (-4.14)	-0.4E-03 * (-3.64)
MM2534M	0.017 * (-2.22)	-0.017 * (-2.06)
P04P	0.150 (1.52)	0.066 (0.63)
D1	-0.068 * (-2.03)	-0.071 * (-2.01)
D2	-0.070 * (-2.91)	-0.067 * (-2.65)
D3	-0.031 (-1.42)	-0.035 (-1.54)
adj R^2	0.921	0.905
DW	1.22	1.10

Appendix 4

Male crime rate against the person estimated by simple linear and semi-log forms
(N = 30)

	simple linear form	semi-log form
constant	-0.885 (-1.17)	-4.400 * (-2.19)
DETECT	0.117 (0.81)	0.293 (0.77)
MPRISON	-0.011 * (-2.90)	-0.031 * (-3.16)
MFINE	0.004 (0.15)	-0.002 (-0.03)
ML	-0.003 (-1.67)	-0.009 (-1.78)
RETAIL	0.030 (1.40)	0.086 (1.53)
MUNE	-0.003 (-0.37)	-0.007 (-0.30)
INCOME	0.1E-03 * (2.50)	0.4E-03 * (2.52)
MM2534M	-0.002 (-0.44)	-0.004 (-0.34)
P04P	0.071 * (2.18)	0.195 * (2.25)
D1	-0.033 * (-2.02)	-0.093 * (-2.13)
D2	0.004 (0.32)	0.014 (0.40)
D3	0.025 * (2.19)	0.061 * (2.03)
adj R^2	0.748	0.761
DW	1.52	1.48

T-values are in brackets

Appendix 5

Female property crime rate estimated by simple linear and semi-log forms
(N = 50)

	simple linear form	semi-log form
constant	0.760 *	3.880 *
	(2.96)	(3.19)
DETECT	0.004 *	0.015 *
	(2.50)	(2.22)
FPRISON	0.4E-03	0.007
	(0.10)	(0.34)
FFINE	0.043	0.281 *
	(1.54)	(2.12)
FL	-0.005	-0.054 *
	(-1.82)	(-4.26)
RETAIL	0.022	0.125
	(1.47)	(1.77)
MUEMPC	0.011 *	0.042
	(2.06)	(1.73)
SERV	0.7E-04	0.4E-04
	(1.64)	(0.20)
MF2534F	-0.006 *	-0.022
	(-2.38)	(-1.89)
P04P	-0.072 *	-0.697 *
	(-2.72)	(-5.52)
D1	-0.031 *	-0.130 *
	(-2.31)	(-2.04)
D2	-0.022 *	-0.104 *
	(-2.32)	(-2.26)
D3	-0.010	-0.055
	(-1.26)	(-1.48)
adj R^2	0.928	0.962
DW	1.13	1.66

Significant coefficients are marked with asterisks.

Appendix 6

Female crime rate against the person estimated by simple linear and semi-log forms
(N = 50)

	simple linear form	semi-log form
constant	-0.139 (-1.60)	-8.728 * (-3.21)
DETECT	-0.018 (1.23)	0.454 (1.22)
FPRISON	0.6E-03 (0.76)	0.017 (0.82)
FFINE	-0.002 (-0.40)	-0.066 (-0.60)
FL	-0.2E-03 * (-2.78)	-0.005 * (-2.83)
RETAIL	0.004 (1.40)	0.916 (1.43)
MUEMPC	-0.001 (-1.14)	-0.023 (-1.07)
SERV	0.2E-04 * (2.14)	0.4E-03 * (2.07)
MF2534F	0.7E-03 (1.62)	0.018 (1.54)
P04P	-0.8E-03 (-0.17)	-0.015 (-0.12)
D1	-0.001 (-0.48)	-0.052 (-0.78)
D2	0.003 (1.63)	0.075 (1.51)
D3	0.005 * (2.82)	0.108 * (2.62)
adj R^2	0.606	0.614
DW	1.55	1.53

Significant coefficients are marked with asterisks.

Appendix 7

D dummy of 1 for quarters beginning from 1979 to 1981 and zero otherwise.

D1 1 for the first quarter and zero otherwise

D2 1 for the second quarter and zero otherwise

D3 1 for the third quarter and zero otherwise

DETECT quarterly data on detection rate calculated by dividing number of cases reported by number of cases detected.
Source : Hong Kong Monthly Digest of Statistics , various issues.

FEM quarterly number of women prosecuted (against the person) divided by 1000 female population. The quarterly data of women prosecuted is estimated by the annual percentage of women prosecuted (against the person) times the quarterly number of people prosecuted (against the person) .
Source : Hong Kong Monthly Digest of Statistics and Royal Hong Kong Police Review , various issues.

FL median annual length of imprisonment for women in months.
Source : Annual Statistical Tables published by the Correctional Services Department.

FM2 quit rate of Form 2 students. This is the percentage decrease between number of Form 2 students to the number of Form 1 student in the previous year.
Source : Education Department

FINE number of offenders fined (men and women aged 15 or above) divided by the corresponding number of people prosecuted (against property / against the person).
Source : Hong Kong Monthly Digest of Statistics , various issues.

FFINE one quarter of the annual number of women fined (against property / against the person) divided by the corresponding quarterly number of women prosecuted.
Source : Annual Statistical Tables published by the Correctional Services Department and Hong Kong Monthly Digest of Statistics.

FLFP quarterly data on the proportion of female labour force members in the female population aged 30 to 39.
Source : Labour Force Survey and General Household Survey , various issues.

FPRISON one quarter of the annual number of women imprisoned (against property / the person) divided by the corresponding quarterly number of women prosecuted.
Source : Annual Statistical Tables published by the Correctional Services Department and Hong Kong Monthly Digest of Statistics.

INCOME calculated by dividing the median monthly income of production and related workers, transport equipment operations and labourers by Consumer Price Index (A). The income includes salary or wages , bonus, commission, overtime, tips and other cost allowances except housing allowance and New Year bonus/double pay.
Source : monthly incomes from Labour Force Survey and General Household Survey ; CPI(A) from Hong Kong Monthly Digest of Statistics, various issues.

LI median annual length of imprisonment for both men and women in months.
Source : Annual Statistical Tables published by the Correctional Services Department.

MALE quarterly number of men prosecuted (against the person) divided by 1000 male population. The quarterly data of men prosecuted is estimated by the annual percentage of men prosecuted (against the person) times the quarterly number of people prosecuted (against the person) .
Source : Hong Kong Monthly Digest of Statistics and Royal Hong Kong Police Review , various issues.

MEN quarterly number of men prosecuted (against property) divided by 1000 male population. The quarterly data of men prosecuted is estimated by the annual percentage of men prosecuted (against the property) times the quarterly number of people prosecuted (against the property).
Source : Hong Kong Monthly Digest of Statistics and Royal Hong Kong Police Review , various issues.

MFINE one quarter of the annual number of men fined (against property / the person) divided by the corresponding quarterly number of men prosecuted.
Source : Annual Statistical Tables published by the Correctional Services Department and Hong Kong Monthly Digest of Statistics.

MF2534F From the last quarter of 1981 onwards, we divide the number of married women aged 25 to 34 (available in quarterly data) by the corresponding female population. Before the 4th quarter of the year, census and by-census provide corresponding figures for the first quarters of 1971, 1976 and 1981, the rest is then estimated by taking the arthmetic mean of the available census and by-census data.
Source : 1971, 1976 and 1981 census and by-census ; General Household Survey (Appendix), various issues.

ML median annual length of imprisonment for men in months.
Source : Annual Statistical Tables published by the Correctional Services Department.

MM2534M From the last quarter of 1981 onwards, we divide the number of married men aged 25 to 34 (available in quarterly data) by the corresponding male population. Before the 4th quarter of the year, census and by-census provide corresponding figures for the first quarters of 1971, 1976 and 1981, the rest is then estimated by taking the arithmetic mean of the available census and by-census data.
Source : 1971, 1976 and 1981 census and by-census ; General Household Survey (Appendix), various issues.

MPRISON one quarter of the annual number of men imprisoned (against property / the person) divided by the corresponding quarterly number of men prosecuted.
Source : Annual Statistical Tables published by the Correctional Services Department and Hong Kong Monthly Digest of Statistics.

MUEMPC quarterly data on the proportion of unemployed men aged 30 to 59 in the male labour force.
Source : Labour Force Survey and General Household Survey , various issues.

MUNE quarterly data on the proportion of unemployed men aged 20 to 29 in the male labour force.
Source : Labour Force Survey and General Household Survey , various issues.

OAP number of cases reported (against property) divided by 1000 population.
Source : Hong Kong Monthly Digest of Statistics , various issues.

PERSON number of cases reported (against the person) divided by 1000 population.
Source : Hong Kong Monthly Digest of Statistics , various issues.

PRISON number of offenders imprisoned (men and women aged 15 or above) divided by the corresponding number of people prosecuted (against property / against the person).
Source : Hong Kong Monthly Digest of Statistics , various issues.

P04P percentage of children aged 0 to 4 out of the total population (annual data)
Source : Hong Kong Monthly Digest of Statistics , various issues.

RETAIL The number of retail establishments per 1000 population. An establishment is an economic unit which operates under one single ownership or control in one principal kind of business. Activities / major groups in retail trades include foodstuffs, alcoholic drinks and tobacco, fuel, clothing, footwear and allied products, consumer durables and other consumer goods.
Source : Hong Kong Monthly Digest of Statistics , various issues.

SERV calculated by dividing the median monthly income of service workers by Consumer Price Index (A). The income includes salary or wages , bonus, commission, overtime, tips and other cost allowances except housing allowance and New Year bonus/double pay.
Source : monthly incomes from Labour Force Survey and General Household Survey ; CPI(A) from Hong Kong Monthly Digest of Statistics, various issues.

WOM quarterly number of women prosecuted (against property) divided by 1000 female population. The quarterly data of women prosecuted is estimated by the annual percentage of males prosecuted (against the property) times the quarterly number of people prosecuted (against the property) .
Source : Hong Kong Monthly Digest of Statistics and Royal Hong Kong Police Review , various issues.